JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

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EDITORIAL NOTES—GAS, &c.

The Translation of Dr. Bone.

THERE will have been a large amount of regret in the gas industry on learning, from the announcement made in the "JOURNAL" last Tuesday, supplemented by further particulars in the present issue, that Dr. W. A. Bone is relinquishing the Livesey Chair at Leeds University—a position of honour which he has filled for all too short a space to make that movement and memorial felt as a living influence in the gas industry. The peculiar gifts and qualifications of Professor Bone fitted him in an eminent degree—we might very properly place the natural prefix before the "eminent"—for the Livesey Chair, and for the lines of work associated with it. But the regret felt that he is resigning the chair will be tempered by the fact that he has been invited to accept a position at the Imperial College of Science and Technology at South Kensington, and that this will give him considerable scope for the exercise of his talents and influence in conjunction with the gas industry among others. The larger the scope, the better for the gas industry; the more numerically the central quarters in which the higher scientific work—educational and research—in connection with the industry is proceeding, the better. From these remarks, it will be gathered that the removal from Leeds to London does not mean the dissociation of Dr. Bone from the industry and from work for it. He hopes to do for its students in the Metropolis and the South of England what Leeds is in a position to do for the North. There is no antagonism between the two. At Leeds, the gas industry has established the memorial to Sir George Livesey; and that is a link between the Leeds University and the gas industry which cannot be severed. But the broadest interests of the industry bid us welcome all opportunity for the development of technologists for its service. Dr. Bone has moved and worked in that atmosphere where lives the spirit that teaches the indispensability of science to industry, and industry to science. This mutuality of interests he will bring to bear upon his work in London.

Building up History.

THE first years of the new century have seen some important statutory changes that have had a large effect upon the fortunes of the gas industry. We have in view particularly the modification of the notions of Parliament as to the standard of illuminating power, the acceptance by it of the "Metropolitan" No. 2 test-burner, and the abrogation of the sulphur clauses, all of which have given British gas undertakings that have taken advantage of these mutations in legislative enactment far greater liberty. There have also been other changes in the decrees applying to the gas industry—such as the new auction clauses, the establishment of a special purposes fund, the recognition of stand-by clauses governing business with those who merely require town gas as a protection against any emergency created by failure of their private gas plants or their electricity supply; the exemption from penalty in the case of failure to supply where private gas plants are in use or electricity is the commom means of performing the service required if such supply would jeopardize service; and, in two or three cases, the authorization given to provide independent gas plants—acetylene, gasoline, suction-gas, and so on—where the ordinary town-gas distribution system does not reach. There have also been other changes—such as the growing adoption of provisions for the appointment of managing-directors, and for the auditing of accounts being entrusted only to professional accountants. There is also the relaxation granted, where promoters desire it, from the old order of fixed discounts. Of all these various changes, those that have given greatest latitude in manufacture and trading have rendered the most generous influences, through the economies permitted, and the more moderate prices at which trading has been made possible.

Another direction in which there has been development during the same period has been in the expansion of supply areas, and in the consolidation, by annexation and amalgamation, of gas concerns. Some very well-known instances of this will occur to most readers who follow closely the political and other changes in the gas industry. Personal opinions differ as to how far this process of consolidation of interests can be carried with fruitfully economic effect. It is quite conceivable that, under certain unpropitious local conditions, or under onerous terms, the process could be carried too far; but of the changes that have been made in this direction (say) during the few years of the present century, we cannot call to mind any that have not proved advantageous to the undertakings and the consumers alike. In the Bills of the statutory Gas Companies that are reviewed in our columns to-day, there are the two amalgamation proposals of companies operating on the borders of London and just beyond, which proposals, from every point of view, appear to be of a most politic order. We refer to the amalgamation scheme of the South Suburban Gas Company with the Bromley and West Kent Companies, and that of the Wandsworth and Putney, Mitcham and Wimbledon, and Epsom and Ewell Companies. The position of these concerns in regard to issued capital is set out in the article on the Bills; and it will be observed from the statement that these two schemes, outside those historic ones in which the London Companies proper have been concerned, are, in respect of magnitude, of unique order, and will change vastly the geographical aspects of gas supply in the extremes of South London and in the near areas of Kent and Surrey. Even so, no one can thoughtfully consider these proposals without seeing how the consolidation of administration and interests must work to the progressive benefit of the undertakings and the consumers. Some of the local authorities will no doubt, more or less *pro formâ*, array themselves in opposition—such as the Bromley District Council; but it will be, it may be imagined, more for the purpose of protecting, and getting the best advantage possible for, their districts than with the object of showing any decided antagonism to the schemes. The prospects of advantage as seen in the Bills are clear, and to the disinterested technical man the potentialities of these fusions have about them a definite future material character. In fact, these Companies are changing the course of, and building up, history.

The other Bills noticed to-day are composed of much the same proposed enactment as those that have been already commented upon in two previous issues. The Bills of the Wakefield and York Companies have prominence. Both are measures of many features; and in both considerable extension of areas is sought. The Wakefield Company are asking for the consolidation of their capital; and they are proposing to obtain power, as other companies have of late been doing, to institute a profit-sharing scheme. Speaking of profit-sharing schemes, as both the South Suburban Companies and the Wandsworth and Putney Companies have such schemes in operation, we can see the Bromley and West Kent Gas Companies' workers, as well as those of the Mitcham and Wimbledon and Epsom and Ewell Companies, in the not distant future, when brought under the new administrations, enjoying the same privileges. The Bill of the York Gas Company contains several provisions of importance to the undertaking. A couple of clauses that are anything but common—referring to the levying of distress on a defaulting consumers' goods and chattels, and to penalties attaching to interference with the Company's officers and servants in the discharge of their duties—are set out *in extenso* towards the end of the article in subsequent columns.

High-Pressure Gas for Street Lighting.

A SHORT time since, complaint was made that a more general keenness was not being displayed throughout the country in the matter of improving street lighting by the high-efficiency lamps now available. Such reports as the one that has been prepared by a deputation from the City of Glasgow to various cities at home and on the Continent will, we venture to think, do something to stimulate interest, trial, and final adoption in main streets of high-pressure gas-lamps. The report is a valuable one, if only for the concise information and useful particulars that it contains, regarding what has been done (in the order dealt with) in Manchester, in Birmingham, at the Crystal Palace Exhibition, in London, and in Berlin. High-pressure gas lighting is carrying favour with it on merit alone. It is on a far different footing now from what it was when only about one-half the illuminating efficiency per cubic foot of gas could be obtained, and when what is now accomplished by one burner and one mantle could only be achieved by two or three burners and mantles. In every way, running economy has been gained in company with the flight in illuminating efficiency. Therefore it is not surprising that members of the deputation were much impressed by the tendency in the cities visited to extend the high-pressure system in the administrative areas. The hint is made that in Westminster, there is a probability of the City Council gradually extending the system; and its expansion in Birmingham appears certain. Berlin can boast of the largest system of high-pressure street lighting in the world. Already 37½ miles of the streets are illuminated by 5400 high-pressure lamps; and 42½ additional miles are mapped out to receive the advantages of the system. The report is alive with detail for the technical man desirous of informing himself respecting the practices adopted. There seems to be a growing preference for Mannesmann steel tubes for this work. The deputation, too, were much struck with what is being done in Berlin with gas of about 10-candle power. Glasgow has been to the fore in Scotland in coming down from the wasteful richness in illuminating power that is a bar to the best use of gas in these times; and the deputation was struck with the wealth of demonstration in Berlin that the candle power of gas *per se* does not count there in achieving illumination on a magnificent scale. Another point that riveted their interest was the simultaneous ignition and extinction of the thousands of high-pressure street lamps in Berlin by pressure waves from the compressor stations. As the result of the experiences of the deputation, a comprehensive test scheme in Glasgow with various types of high-power high-pressure lamps is on the *tapis*, preliminary to something of a still more extensive character being adopted. The report is certainly one to be read with care from beginning to end.

Illuminants and Colours.

A SUBJECT upon which little work has been done is the relative effect of artificial illuminants in preventing the proper interpretation by the eye of different colours. It is generally known that—ladies expecially appreciate the fact—that artificial lights do impart a different appearance to colours from that which they possess during the hours of what may be called normal daylight. But there has been only a small amount of inquiry to ascertain the deceptive effects of the several forms of illuminants in the matter of judging colours, and the varying degree of those effects with different illuminants and colours. Mr. T. E. Ritchie has lately been making a serious attempt to photographically investigate the matter; and the results he detailed in a paper, headed "Colour Discrimination by Artificial Light," which he read last Tuesday before the Illuminating Engineering Society. These results are certainly most instructive from the relative point of view, although there may be doubts as to their absolute scientific accuracy. But the results having relation—being derived under the same conditions—they will form a useful guide for determining approximately, within the limits of the lights examined, the means of illumination that really have least effect in destroying daylight colour perceptions. To have practical guidance to this extent is of importance for the illumination of all workplaces or shops in the products or goods of which colours have part. Mr. Ritchie entitles his paper colour discrimination by artificial light; but he proceeds to show that with all the lights with which he instituted tests, it is impossible to make faithful colour discrimination.

The best results, photographically rendered, were obtained with the inverted electric arc, only two of the colours with the light of that lamp being different—and that slightly—from the normal daylight rendering of the colours. But the experiments were deficient, as was pointed out by the Chairman (Mr. F. W. Goodenough) in that they did not include a modern high-pressure inverted gas-lamp; and as this lamp is very popular with those shopkeepers who prefer that the goods displayed in their windows shall be seen as near as possible in the colours presented during daylight, it would be interesting to ascertain how it comes out under Mr. Ritchie's method of adjudging lamp values for colour discrimination. The only modern gas-lamp that was put to test was an inverted low-pressure one; and for the purpose with which the author was dealing, there was not much to choose between this and the metallic filament electric lamp. The ordinary arc lamps, however, with which the gas industry's high-pressure gas-lamps are in competition, give results—especially the yellow flame arc lamps—that should induce any shopkeeper, particularly any draper, who desires to do his goods the justice of exhibiting them as near as possible in the colours and shades of colours they present in daylight, to promptly banish them in favour of a type of lamp that is practicable for the purpose, and that does not act so destructively upon the tones of the colours of goods for sale. In addition, the unsteadiness of the electric arc lamp—flame arcs painfully so—does not assist in colour discrimination; but it must have some bad influence upon those sensations that contribute to the production of accuracy in visual judgment.

Gas Companies as Chemical Manufacturers.

WE are afraid the Chemical Section of the London Chamber of Commerce has discovered a mare's nest. Mr. W. Pearce, who is a member of Parliament, and head of a large chemical works in the East-end of London, has called the attention of the Section to the fact that, in the Wandsworth and Putney Gas Bill, the Company are asking, in the general purposes clause, for power to "produce, purchase, store, sell, "dispose of, and deal in" residuals and their products, and to what is not a fact that the South Suburban Bill contains a similar proposed power. The latter statement was the first error, as a general purposes clause does not appear in the South Suburban Bill. Then Mr. Bulwer Howell, treating of the matter from the legal standpoint, stated—he did not quote his authority for the statement—that the powers sought in these two Bills distinctly went beyond those at present enjoyed by gas companies; and Mr. Pearce also said that the powers sought would not, in one respect, be on a level with those already granted to gas companies under existing Acts. Both gentlemen erred in this particular. The term in the Wandsworth clause that is obnoxious to these critics and objectors is the word "pur-"chase," which it is considered will give the Company some peculiar right that is not enjoyed by other companies, and will enable them to come into competition with chemical manufacturers on terms that will place the latter at a disadvantage. The Wandsworth Company have only to point to the powers possessed by neighbours for disproof that the power to "purchase" is in excess of existing rights; and there is an amount of statutory precedent for inserting the word "purchase" in a general purposes clause. It is a moot point, however, whether the term is necessary to enable the Company to "purchase," in view of the fact that the clause proceeds, in the words of the "Model" form, to enable the Company to "deal in" residuals and products therefrom. This, however, may be a debatable point; but there is certainly no question that the Company are not asking for any peculiar power. With only limited, and not exact, information before them, the members of the Chemical Section of the Chamber of Commerce decided to petition against the Bill.

It is alleged that the power sought is one that is highly dangerous to the chemical trade, that it will enable the Company to purchase chemicals for manufacturing purposes without any restriction whatever, and will also allow them to engage in unfettered competition with the chemical trade, and on unequal terms. What does this single-sided argument amount to? In the first place, the chemical manufacturers, enjoying free trade themselves in respect of purchase and sale, desire to prevent the Gas Company having the same privileges. In other words (though we do not suppose many thoughts regarding the chemical manufacturers have crossed their minds), what the Gas Com-

pany propose would establish, in this branch of their business, terms of equality with the chemical manufacturers; while the chemical manufacturers (who are not under any special statutory obligations) wish to place them on terms of inequality. They desire to deprive the Gas Company of the ordinary rights of the manufacturer to conduct his business in the manner that enables him to secure the largest measure of economy; and the desire is therefore more selfish than generous. With the Company it is entirely an economic question whether they purchase raw residuals in order to realize higher productive results to the benefit of the undertaking and, through it, of the consumers of gas, who are, under the sliding-scale, the largest beneficiaries from economical working. We have no fear that Parliament will answer the petition of the Chemical Section of the Chamber of Commerce by placing any restriction upon the Company that would mean loss of economy and injury to the community, and by turning against their own precedents.

We should be sorry to think that in this matter there is more than meets the eye. The chemical manufacturers have had very good pickings out of the gas industry, and will continue to do so, though with an expansion of the demand for tar in other directions, the trading relations of the sellers and purchasers of this raw residual may henceforth be on a somewhat different footing. We cannot help these turns of the wheel of fortune. And private interests are not, as a rule, allowed to stand in the way of progress—progress through which the community benefits.

The Ilkeston Gasholder Disaster.

Up to the time of going to press, nothing fresh has transpired that supplies any elucidation of the cause of the collapse of the steel tank of the gasholder at the Ilkeston Gas-Works that originated the recent disaster. Mr. J. Ferguson Bell has not yet issued his report; and this indicates an exhaustive investigation. Mr. Samuel Glover has sent in a report that points to the unusual character of the accident, has a reassuring note about it for the people of Ilkeston, shows clearly the sequence of events, and advances all the proof that is necessary that there was no explosion, but that the principal part of the damage was occasioned by the violence of the temporary flood, which was quickly spent, but played remarkable havoc in its short career. Apparently more is to be heard from Mr. Glover on the question of the cause; for he remarks: "The exact primary cause of the first accident has not yet been ascertained." It is the primary cause that is the matter of engineering concern. On the subject of the origin, a correspondent suggests that, among the possible causes that should be considered, are the strain due to the bursting pressure of water; and the external forces induced by the gasholder bell, which, in the Gadd and Mason system, must all be transferred to the bottom curb acting direct on the tank. The communication of this correspondent follows the reproduction of Mr. Glover's report in other columns.

The Coal Outlook.

In a little more than five weeks from now, the notices will expire that the miners will hand in as the result of the conference of the Miners' Federation last week in Birmingham; but this very conference has, at the same time, given a more optimistic feeling than prevailed on the first information being published as to the result of the ballot of the miners on the minimum wage question. The ballot, by a vote of 445,801 against 115,721, has authorized the Federation to take the extreme course of bringing all the force of a national strike of miners to bear on the coal owners if they continued to decline to yield on the minimum wages claim. The first step in applying pressure was to order the handing in by miners throughout the country of notices to terminate at the end of February; but a second resolution that was passed indicates a desire on the part of the men's leaders to negotiate with the view of averting the extremity of open war, and the imperilling of the continuity of the work of the industries of the country. It has been generally accepted that there is sincerity about this, and that the resolution as to continuing the negotiations for a settlement has not been merely passed with the view of saddling the owners with a greater share of the blame if war is declared, and the country's coal supply is interrupted. It is too early to talk of the possible issue of further negotiations. But it must not be overlooked that the vote of the miners does not give their leaders much scope for compromise; and the owners have already declared they cannot concede the minimum wage. The English Coal Conciliation Board will meet in London to-day; and on Feb. 1 the Miners' Federation will once again confer. Meantime, the miners in most districts appear to be working normally, though naturally there is a large amount of excitement, and more noticeably in the districts where there is the greatest display of the militant spirit. The suggestion as to a curtailment of output in order to prevent the accumulation of stocks has not so far been acted upon to any serious extent; and gas-works in and about London appear to be generally receiving fairly regular deliveries. There are still five weeks or so before the miners' notices can expire; and there is not the slightest indication at the moment what the days or the weeks of the period will bring forth, nor, if negotiation fails, what is in store at the end of the period for the large users of coal.

A Thoughtful Presidential Address.

The presidential address that Mr. C. D. Cawthra delivered before the Yorkshire Junior Gas Association on Saturday was a thoughtful composition of sound advice to the juniors, of healthy criticism, and of suggestiveness formed by looking beyond contemporary conditions and examining possibilities. There was a good deal of originality packed into its short length; and so much that almost every paragraph has its discussable point. There is not the slightest doubt about it that most of our methods fall short of the ideal; but it is an excellent thing to have ideals to work for, and it is an equally excellent thing that new ideals come along to spur us on in the endeavour to make fresh progress. It would be a poor and uninteresting world for workers in which all ideals were accomplished facts; and therefore we are glad that the gas industry is surrounded by ideals for the juniors of the gas profession to strive after. It is an industry that offers large and fresh scope, in every direction. In the matter, for example, of its gas production, it falls short of the ideal. But we are not persuaded by what Mr. Cawthra says that a solution is going to be found in an adaptation of the Mond process. There is, in this system, a large conversion of the nitrogen in the fuel used into ammonia; but the gas suffers hugely. It seems to us that the "suitable modifications" which the Mond "process" would have to undergo in order that it might be utilized for manfacturing illuminating gas would have to be so seriously large that all identity with it as a "process" would disappear. The choice lies between the large ammonia yield of the process, and an improved gas. They cannot both be realized. However, Mr. Cawthra entertains an idea that the system might, by simple means, be brought to the necessary conditions for illuminating gas production, and that with a high heat efficiency. There is work here for the brain and hand of Mr. Cawthra.

The Question of Picketing.

The Trade Disputes Act Reform League, who are at present engaged in drafting a Bill to deal with the matter indicated by their title, are, it is stated, considering a number of proposals in connection with picketing operations; and it is anticipated that the necessary amendments will shortly be decided upon. To facilitate the work of drafting the Bill, the League invited opinions from a large number of employers, workpeople, and others interested in the matter; and the proposals submitted can be divided into three classes: (1) Those to limit pickets to a small number, to be known by badges or some other distinctive mark, and render it illegal for other persons to attend places of business where a strike is in progress; (2) those to substitute alternatives to picketing; and (3) those to render picketing in any shape or form an offence punishable by law. It seems—and this is a view of the matter which can be easily understood by those who have studied at all closely the proceedings in connection with recent industrial disputes—that the great majority of the League's correspondents advocate strongly the abolition of picketing, whether it be carried out at a place of business or at a worker's residence. This would (in one sense at least) be a radical cure for the existing unsatisfactory condition of affairs; while the first two proposals would probably be merely palliative measures. The League, it may be pointed out, are collecting, in support of their Bill, concrete instances of lawlessness and destruction of property "which the law has been powerless to prevent."

PERSONAL.

Mr. JOSEPH WILLIAMSON, the Manager of the St. Bees Gas Company, has been appointed Manager of the Arlecdon and Frizington Urban District Council's gas-works.

Mr. CHARLES N. WOOD, who for some years has been Acting-Engineer of the Barnstaple Water Company, has been appointed Secretary and Manager, in succession to Mr. C. W. Parkin, who is leaving Barnstaple for Canada.

At last week's meeting of the Manchester Literary Club, Mr. THOMAS NEWBIGGING read a paper entitled "Memories," in the course of which he related a number of amusing stories bearing upon his experiences while resident in the Rossendale Valley.

OBITUARY.

The death has lately occurred of Mr. HERBERT E. S. BAKER, who, in 1899, succeeded his father, Mr. Edward Baker, whose assistant he had been, as Engineer and Manager of the Reading Gas Company. This position he held till the end of 1902, when he resigned, and Mr. D. H. Helps, then of Redhill, was appointed.

The death occurred last Tuesday, consequent upon a severe operation, of Mr. JAMES SEWELL NEVILLE, of Sloley Hall, Norwich. Deceased was born in 1827, and was the third son of the late Rev. John Neville White, of Tivetshall, Norfolk. He was for several years a Director of the Brentford Gas Company, in which he always had a large interest; and in 1893 he was succeeded on the Board by his son, Mr. Reginald Neville, M.P. for Wigan.

We regret to record the sudden death last Wednesday, as the result of heart failure, of Mr. HAROLD IAGO, one of the Station Engineers of the Gaslight and Coke Company. He was engaged in the discharge of his duties the previous day; and his death occurred at his residence, Battle Bridge House St. Pancras. He was in his 55th year. Mr. Iago was appointed Engineer of the Fulham station in April, 1877; and seven years later he was transferred to Beckton as second Assistant-Engineer. In May, 1877, he went back to Fulham as Deputy Superintendent, and was raised to the position of Superintendent there in January, 1890. In November of the following year, he was transferred to Beckton as Resident Engineer; and in March, 1906, he was made Station Engineer for Shoreditch and St. Pancras. Mr. Iago was one of the most highly respected officials of the Company—enjoying the confidence of the Directors, and the esteem of all his colleagues with whom he was brought in contact.

PROFESSOR BONE'S NEW APPOINTMENT.

IN the last number of the "JOURNAL," we announced that Dr. Bone is about to resign the Livesey Chair at the Leeds University, in consequence of his having accepted an invitation from the Executive Committee of the Imperial College of Science and Technology, at South Kensington, to take the position of Professor of Fuel and Refractory Materials, with the general supervision of the new Department of Chemical Technology which it is proposed to inaugurate at the beginning of the next academic session. As already mentioned, the subjects which it is proposed to develop in the first instance are: (1) Fuel and Refractory Materials; (2) Chemical Engineering; and (3) Electro-chemistry. Each of them will be in charge of a Professor who is a "specialist" in his subject; while Dr. Bone will exercise general supervision as regards organization, &c., in addition to his special responsibilities as Professor of Fuel and Refractory Materials. With regard to the subject just named, it is intended to deal with it comprehensively, and to build and equip very fine laboratories. Under "Fuel" will be included solid, liquid, and gaseous fuels, as well as "residuals," &c.; and in this connection Dr. Bone hopes to be able to provide fully for the higher educational and research requirements of the coal-gas industry. Hence, in resigning the Livesey Chair, he does not wish it to be thought that he contemplates severing his connection with the gas industry, but rather that he desires to strengthen it by organizing in London opportunities for students from the Metropolis and the South of England at least equivalent to those now offered in Leeds.

Dr. Bone hopes it will not be considered that the new movement in London is conceived in a spirit of opposition to the work of his present department and the Livesey Chair in Leeds. Nothing, he feels sure, is farther from the minds of the authorities of the Imperial College. The department presided over by the Livesey Professor in Leeds will, no doubt, ever be devoted specially to the interests of the coal-gas industry. The new Department of Fuel in London, while developing perhaps on broader lines than will be practicable in Leeds, will nevertheless endeavour to secure the active interest of the coal-gas industry in such aspects of its work as may more nearly concern that industry.

It is recognized that we, in England, are much behind either America or Western Europe in the public provision for teaching and research in applied science. In pure science we may fear no comparison; and the strength of our position provides us with splendid material for the training of technologists, if only it can be made use of. The task of the new department will be to render some of this material immediately available for our industries—the gas industry among the rest. Dr. Bone has great faith in the future industrial position of this country, if only we do not neglect our duty in this important respect; and he considers there is plenty of room for new developments such as are contemplated in London, without interfering at all with the usefulness of those already established.

It must be quite understood that Dr. Bone's resignation of the Livesey Chair will not take effect until the end of the present academic session. His new duties do not begin until the commencement of the session 1912-13.

THE ILKESTON GASHOLDER DISASTER.

Report by Mr. Samuel Glover.

In the account of the recent catastrophe at the Ilkeston Gas-Works, which appeared in the "JOURNAL" last week, it was mentioned that Mr. J. Ferguson Bell and Mr. Samuel Glover had been called in by the Corporation to report as to the cause of the disaster. The latter gentleman has complied with the instructions in this matter he received from the Town Clerk (Mr. Sidney F. James), and subsequently confirmed by the Gas Committee, and has reported as follows to the official named.

I have made a careful inspection of the wrecked gasholder No. 3, and the damage done to gasholder No. 2, and the buildings and apparatus at the gas-works, with the view of ascertaining the cause of the accident which first occurred and the after-events.

At the outset, I may assure your Committee that it is quite an unusual accident to happen to any gasholder; and the exact primary cause of the first accident has not yet been ascertained. It is quite clear, however, that there was not an explosion of gas within any of the gasholders; and I can assure your Committee that there is no cause for fear that anything of the kind will happen in the future. This is proved by the following facts:

1.—The position of the two lifts of holder No. 3, after the accident occurred. These lifts are standing upright in the yard, close to the ruined tank which contained them, in a comparatively slightly damaged condition, notwithstanding that at the time of the accident they were three-parts full of gas.

2.—The settling-down of holder No. 2 in its underground tank after it had been damaged by the collapse of holder No. 3.

3.—The impossibility of setting fire to coal gas without its being mixed with oxygen in some form or other.

As to the firing of the gas, what probably happened is that the gas escaped from holder No. 3, and was fired, owing to its mixture with the air, before the gas escaped from holder No. 2, consequent upon its sides being damaged through the collapse of holder No. 3; and that the escaping gas from holder No. 2 was set on fire by the burning mixture of air and gas from holder No. 3. It is improbable that there was any explosion of gas at all, as on being fired the gas burnt itself out and caused the holders to settle, as before stated.

The great damage caused by the accident is not the result of an explosion of gas, but is due to the action of the great wave of water set free in such an unusual manner by the bursting of the outside steel tank, which, having been erected almost on the yard level, allowed its contents to flow across the yard. Your other gasholder tanks not being of this description, this sort of accident can in nowise be repeated; and so you can allay any fears, and give full assurance to all people who may have become alarmed.

Strains and other Forces.

A correspondent who has had considerable experience in connection with gasholder construction calls attention to a fact which appears to be lost sight of when attributing the primary cause of gasholder disasters to the failure of the tank, and not to the floating holder, whether on the Gadd and Mason or any other system. He says: "If an above-ground gasholder tank bursts, it must be due to one or other of the following causes: (1) The strain due to the bursting pressure of water. (2) The external forces induced by the gasholder bell, which in the Gadd and Mason system must all be transferred to the bottom curb acting direct on the tank. These forces may be derived from (*a*) ice formation, causing an obstruction to free working; (*b*) wind; or (*c*) structural stresses. (3) The forces acting upon the tank due to subsidence of foundations. (4) Foul play. It is the fashion to attribute failures of this kind to (3) the foundations giving way, or more rarely to (4) the last-named cause—these being the simplest. But in my opinion more attention should be directed to the two first-named causes in all inquiries of this kind."

Adjourned Inquest on the Victim.

The adjourned inquiry by the Derby District Coroner (Mr. W. H. Whiston) in regard to the death of the young servant girl who was drowned in the cellar of a shop after the explosion [see *ante*, p. 146] is to take place to-morrow, when it is understood that some evidence of an interesting technical character will be forthcoming as to the possible causes of the wrecking of the principal gasholder and the damage to other parts of the gas-works plant.

ELECTRICITY SUPPLY MEMORANDA.

Recovery of "Meat" from the Atmosphere—The Coal-Fire Oven and the Gas-Cooker—Evaporation or Waste of Solids—Vent, Moisture, and the Use of an Enclosed Meat-Roaster—Relative Heat Efficiencies—More Eccen-Tricities.

WANTED, a company for the recovery from the atmosphere of the tons of "meat" that are daily lost through, according to electrical fiction, cooking in gas-stoves. "Meat" is a term that suggests something solid and nutritious; and therefore it is a great pity that all this alleged useful food should be allowed to float away in the atmosphere from the millions of gas cooking-stoves that are now in use in this country. If it really were "meat" that was wasted, in view of the quantities that would daily be dissipated in the atmosphere, there ought to be seen in our thickly populated towns some visible signs of it, and more especially during the hours that Sunday dinner cooking is in progress. If we were asked to suggest a Board of Directors for the meat-recovery company, there are a few names available of electrical gentlemen who have been specially prominent in advertising their ignorance on the matter by talking of the low heat efficiencies of gas-cooking stoves (without quoting the types), and of the tremendous waste of "meat" that goes on through their utilization in the process of baking.

The humbug that is being circulated in this connection from electrical quarters—humbug for which another name is misrepresentation—is on the low level with much else that has had electrical origin in the campaign against gas. A significant point is that our electrical opponents do not advance any proof of their statements by mentioning how, when, and by whom their alleged experiments with gas-ovens were carried out, and the types of ovens that were employed. Only last week we called attention to a statement in a leaflet on electric cooking that is being issued by the Electricity Publicity Committee, in which it is asserted that the waste of "meat" by cooking in a gas-oven is slightly more than in the case of "meat" cooked in a coal-fire heated oven. That is, as we then stated, untrue; and we know it to be so from home experience. But let us quote what is said on this point in Cassell's "New Dictionary of Cookery:"

> As the result of a long series of experiments, it has been proved that meat roasted by gas loses less in weight than when cooked in the oven of a coal range. In other words, a larger proportion of the nutritious juices of the meat are retained when it is cooked by gas. Looked at from this point of view, it must be acknowledged to be an economical way of cooking. The heat of a gas-stove can be regulated with the utmost exactness, the required heat can be got just when it is wanted, and either a slow simmering fire or a brisk boiling fire can be had at a moment's notice. There need thus be little or no waste of heat, as the requisite amount for any required purpose can at all times be got.

Really we cannot understand how the Electricity Publicity Committee, after the long years of experience there have been in this connection, could have made themselves parties to this misrepresentation. If electric cooking cannot advance far on its own merits, the help it will receive by deception will not prove of very much value to it.

Now when there is talk of waste of "meat" in cooking, it is a misapplication of the term. We know that, however meat is cooked, there must be a difference between the original weight of the meat and that resulting from the process. The degree of the difference is due to the temperature at which it is cooked, to the amount of vent that an oven offers to the escape of moisture, to the drying effect of the source of heat on the atmosphere of the oven, and to the characteristics of the meat—whether, for instance, it contains a large proportion of fat. All meat—of course, it is elementary knowledge—contains a large percentage of water; and water represents weight. But water is not "meat." Whatever the means of baking, there must be evaporation; and after a high temperature has been first obtained in an oven so as to coagulate the external albumin, if there is proper regulation of the temperatures afterwards—as they can be regulated to any desirable degree in a gas-oven—evaporation should be at a very low point, and the loss of weight on a low scale. If the meat is so cooked, the red juices will be found when it is carved hot; but otherwise, if an excessive temperature has been employed, the red juices have not escaped, but they have become more or less concentrated. The facts clearly show, in the first place, that the amount of evaporation depends largely upon the temperature employed; and the degree of evaporation is represented by the lessened weight of the meat when cooked. But what is evaporated has not the money value that was paid to the butcher for the meat. To say that it has is an absurdity in computation, and a piece of humbug for which the electricians are responsible, and which they are disseminating throughout the length and breadth of the land.

We come to another point—that the amount of vent from an oven will, in addition to temperature, have an effect upon the amount of evaporation. This is a point we are perfectly willing to grant electricians. They concede that there is an amount of waste of "meat" (which we call evaporation) in baking in an electric oven. Now supposing no vent is provided in an electric oven, but that the atmosphere is saturated with the moisture evaporated from the meat, the oven is of no use (while being employed for the baking of meat) for obtaining the necessary crispness in the cooking of pastry. This is the experience of expert cooks. In a gas-oven we can get all the advantage that we admit there is in not over-drying the meat, and at the same time use the oven for any purpose of baking desired. For this simultaneous use for different purposes, there is no occasion to have recourse to what is described by one of the flippant electric cookery lecturers as the "greasy, messy business" of paper bag cookery. A fortnight ago we alluded to the use of an enclosed "meat-roaster"—of proper construction—in a gas-oven (p. 81); and this roaster, in more than one size, has been put to considerable test since then. Placed in such an enclosed, inexpensive, and durable baking device—which has less cubical capacity than an ordinary electric oven—there is a very small amount of evaporation. It cannot be otherwise; and therefore there is a smaller loss in weight. There being lessened evaporation, the nutritious juices remain in liquid form, as is evidenced when carving. The moisture evaporated from the meat being confined in the meat-baker, the oven can at the same time be used for pastry or any other purpose. What is also of importance is that a sufficient temperature is maintained when cooking has commenced by turning the gas low, and so further saving is effected. This is practical experience. Furthermore, there is no smell from burnt grease, which smell the electricians fondly imagine to be, and hope they are, poisonous fumes, and are peculiar to the gas-oven. Electric ovens are not free from the adherence of fat to the sides unless they are carefully cleansed after each time of use. However, in this enclosed method of baking in a gas-oven is found an answer to all their argument in favour of the electric cooker—argument that is fallacious when applied to a comparison with a properly constructed gas cooker handled in an intelligent fashion.

We need not on this occasion go into the questions of installation costs, of the maintenance costs of electricity kitchen appliances, of the want of durability of such electric appliances, of their inconvenient breakdowns, of disconcerting electrical shocks, nor into the point that electricity is sold for cooking purposes at (say) only 20 or 25 per cent. of lighting prices in order to attempt to compete with gas for cooking charged at lighting rates. If the well-advertised figment were true as to the actual money saving in "meat" effected by electrical cooking, the electricity suppliers should be able to do a large business in cooking at prices above those charged for lighting. But can they? Facts speak louder than the words of enthusiastic electrical engineers and the easily wagged tongues of lecturers.

Leaving these matters, some reference may be made to another subject. The "Electrician" has been reproaching the Electricity Publicity Committee for not having retorted, in the advertisement columns of the "Manchester Guardian," to the reply of the British Commercial Gas Association to the outrageous advertisement that emanated from some electrical source at the time of the Manchester Smoke Abatement Exhibition. The Electricity Publicity Committee may have some very good reason, of which the "Electrician" is not aware, for not responding to the advertisements of the British Commercial Gas Association. Now a Mr. F. S. Grogan, who is one of the lecturers for the "Tricity" cookery sets, has written a letter of gossamer substance to our contemporary, which he apparently intends to serve as an example of how the gas advertisements in question could have been absolutely blown to pieces in the eyes of the public. Our contemporary apparently appraises the letter at a very high value. In it, Mr. Grogan owns to being the author of that piece of absurdiity that the heat efficiency of a gas-cooker is only 12 per cent. He asserts that he has personally obtained this in practice, as well as an 80 per cent. efficiency with the "Tricity" electric cooker. We have not tested the heat efficiency of a "Tricity" electric cooker; but if we were to accept Mr. Grogan's statement as true, that the losses from that thin sheeted oven (long and triumphant life for which in the hands of an ordinary domestic we should not care to guarantee) is, during the time of use, only 20 per cent., then forsooth the Tricity people have not any substantial margin left for improvement, while the gas people still have 88 per cent. margin upon which to work.

The 12 per cent. efficiency Mr. Grogan states has been obtained by him in practice, and with an ordinary commercial gas-cooker. As he owns up to the authorship of this really astonishing statement, he will assuredly feel that he ought to back up the assertion by telling us which type of cooker he used, and the methods he adopted in ascertaining the so-called efficiency. We invite him into our columns to set out his statement on this point, as, by securing a full explanation, we shall be able to see whether his efficiency-testing methods are open to destructive criticism, or are of a scientific character that are worthy of credence. Until he shows that the basis of his so-called efficiency is unassailable, there would be no good in discussing the pretty little table that he builds upon it. He quotes in support of his statement, another one made in this instance by a Mr. Loewenthal, before the American Institution of Electrical Engineers. We have as much faith in this respect in the accuracy of Mr. Loewenthal as in Mr. Grogan, until we know more of the methods adopted for obtaining the relative efficiencies. Mr. Loewenthal quotes the efficiency of the electric cooker at 85 to 95 per cent. This is higher than Mr. Grogan accords to the "Tricity" cooker; so that the latter is evidently not the best electric cooker on the market. For the gas-cooker, Mr. Loewenthal quotes an efficiency of 15 per cent. This is 3 per cent. more than is allowed by the Tricity cooker advocate; and yet we object to the American gas-cooker being used as any criterion of what can be done by a well-made British gas-cooker

in the matter of heat efficiency. From observation, we hold the view that the British gas-cooker makers have nothing they can usefully copy from their American contemporaries. Mr. Grogan's figures do not in this matter show anything "conclusively," nor are they a "complete answer" to what he chooses to describe as the "absurd and ridiculous relative costs" stated in the British Commercial Gas Association's advertisements. Let us see the foundation for these efficiency figures, then we will frankly say whether or not they are really acceptable as "conclusive" or as a "complete answer." Mr. Grogan also says that "an official of one of the largest gas companies" was recently so "astounded" at the advance of electric cooking, that he left his order for a complete Tricity outfit. It is more likely he gave the order with a view to putting the outfit to some lengthened trial, so as to test the assertions of Mr. Grogan, or one of the Company's other salesmen.

Now this same Mr. Grogan urges, or so we interpret his statements, that he is a greater believer in practice than in theory. Well then practice gives the lie direct to the statements that he makes about the use of gas-cookers. If gas-cookers did for their users all he says they do, is it reasonable to suppose that they would have gained a use to the extent of approximately 3 millions in the United Kingdom, or would gas-cookers have continued in use for the last 25 to 30 years in the manner they have done? Let the electricians give a sensible answer to that question. We have invited Mr. Grogan into our columns on the subject of his efficiency tests; we invite him at the same time to answer a few other points on which we should like his explanations of certain postulation of which he is the author. He says that "when cooking, the escaping heat, poisonous fumes, and smell, give the person using the gas-cooker a headache." As the present writer and his friends almost without exception use gas-cookers in their homes, he asserts that this statement is an untruth. But we ask Mr. Grogan to put names to the "poisonous fumes" to which he refers. He also goes on to say that the user of the gas-cooker "gets sore eyes, and a pain at the back of them; and she feels a choking sensation in her throat." There, again, practical experience and popularity are the effectual contradictions of these inventions of the vivacious imagination of Mr. Grogan. But we come to a remarkable assertion that suggests some wonderful monkey tricks on the part of the technical servants of the gas industry. The cook, says the veracious Grogan, "has to watch very carefully *all the time*, or the food will be spoilt," and why?—Mark this all you gas engineers who are manacled hand and foot with standards for the infraction of which you are penalized—"because the quality of the gas varies, also the pressure, by 600 to 700 per cent." This was published in the "Electrician"—a paper that is not usually associated with the weekly comics. We ask Mr. Grogan to explain these technical ticklenesses and quick-change feats; and why in London they do not show themselves in the returns of the testing authorities who are independent of the gas companies, and are the guardians of the interests of the consumers in the matters of quality and so forth? We do not think there is need to go into any more of this trivial matter. But we do hope Mr. Grogan will candidly reply to the questions we have raised upon his letter. So far as electric cooking is concerned, its advocates paint its merits in such vivid colours, that it is a pity to spoil their effect by adding the mud of gross exaggeration.

LOCAL INCOME AND EXPENDITURE.

Finances of Urban District Councils.

THE figures which were given in the issue of the "JOURNAL" for the 2nd inst. with regard to the accounts of the borough councils for the year ending March 31, 1910, may be followed now by some statistics relating to the finances of the urban district councils (other than town councils) for the same period. The information is derived from Part V. of the Annual Local Taxation Returns.

The number of urban district councils in England and Wales, other than town councils, dealt with in the report is 818, which is an increase of three compared with the previous year. The receipts of the councils, excluding receipts from loans, amounted during the year 1909-10 to £11,655,743, including £903,770 on account of elementary education. The total receipts of the councils for the preceding year were £11,525,958. These receipts included sums received from county councils, and also grants under the Agricultural Rates Act. The receipts from general district rates amounted to £5,411,149, and from other rates to £989,554. Among the other items on this side of the accounts were: Gas-works, £1,011,098 (compared with £1,006,446 in the preceding year); water-works, £711,840 (against £707,376); and electric lighting undertakings, £383,548 (against £359,718). It appears from the financial statements for the year now referred to that the receipts in respect of gas-works included £755,975 from gas-rentals, and £222,689 from the sale of residual products. The receipts in respect of water-works included £498,178 from water rates, rents, or charges for domestic purposes within the respective districts of the councils owning the water-works, and £146,027 for water for other than domestic purposes.

The total expenditure of the urban district councils for the twelve months ending March 31, 1910, excluding that defrayed out of loans, was £11,573,090, as compared with £11,437,768 for the preceding year; so that there was an increase on this side of the accounts of £135,322. The following items of expenditure (in which charges for interest and repayment of loans are included) may be compared with the year 1908-9: Public roads and streets, £2,062,807 (against £2,058,199); education, £1,825,613 (against £1,767,060); gas-works, £948,321 (against £969,317); public lighting, £521,569 (against £511,079); sewerage and sewage disposal, £1,184,594 (against £1,207,629); water-works, £788,931 (against £785,385); electric lighting, £379,348 (against £375,535). The loan charges—repayment of principal (otherwise than out of sinking funds or redemption funds), payments to sinking, &c., funds, and interest on loans—came to £3,103,931, as compared with £2,999,863 in the preceding year. Of the principal and interest so paid, and allocations to sinking funds, £260,775 was on account of gas-works, £382,933 of water-works, £197,705 of electric lighting, and £1894 of public lighting. Of the expenditure on public lighting, exclusive of loan charges (£519,675), £105,763 was on account of electric lighting, and £413,912 on account of "other" lighting. With reference to the last-named figure, it is pointed out that this excludes the loan charges for public electric lighting, which are included under the head of "electric lighting," as they cannot be separated. The aggregate length of main roads maintained and repaired by the councils at the commencement of the year 1909-10 was 2389 miles; while the total length of other roads maintained and repaired was 11,692 miles.

The expenditure of the urban district councils out of loans (including certain sums spent in anticipation of loans) during the year now being considered amounted to £2,522,588. Of this sum, £188,418 was on gas-works, £303,836 on water-works, £146,098 on electric lighting, and £483,377 on sewerage and sewage disposal works. The total expenditure defrayed out of loans in the year 1908-9 was £2,203,447. Substantial increases are shown in the expenditure on account of gas-works, water-works, and sewerage and sewage disposal works; while there is a decrease under the heading of electricity. The total amount of loans raised during the year was £2,481,034, including the following sums: Gas-works, £137,745; water-works, £296,516; electric lighting, £161,640; and sewerage and sewage disposal works, £536,506. The amount of loans raised in the preceding twelve months was £2,340,923. There are increases for water and sewage works, and decreases under the heads of gas and electric lighting.

The amount actually repaid during the year in respect of loans (including payments out of sinking or redemption funds, but excluding unexpended balances of loans applied to the repayment of principal) was £1,803,091; and the outstanding loans of the Councils at March 31, 1910, amounted to £37,068,134. Of this debt, the sum of £8,614,144 was for purposes of sewerage and sewage disposal, £5,621,352 for water-works, £4,053,140 for education, £3,449,329 for gas-works, £3,297,823 for street improvements, and £2,511,398 for electric lighting. The amount remaining at the end of the twelve months in sinking and redemption funds for meeting loans repayable in this way, was £629,346. The sum paid into the funds during the year was £237,047; and the amount taken out of them and applied to the repayment of principal, was £229,047.

According to the census of 1901, and taking into account alterations of area since that time, the total population of the urban districts other than boroughs at March 31, 1910, was 6,835,853. The total assessable value of the districts for the purposes of the general district rates, or other rates out of which the general expenses of the councils were defrayed, was £34,527,455.

Gaslight and Coke Company's Dividend.—We are informed by the Secretary of the Gaslight and Coke Company, Mr. Henry Rayner, that the accounts for the past half year show that (subject to audit) the balance to the credit of the net revenue account will enable the Directors to recommend the payment of a dividend at the rate of £4 14s. 8d. per cent. per annum, carrying forward to the next account £726,747 13s. 10d. The dividend this time last year was £4 13s. 4d., and the carry-forward was £625,688. There is consequently an increase of 1s. 4d. per cent. in the dividend, and of £101,059 in the carry-forward, the amount of which for 1910 was £456,993, or £269,754 less than that for 1911.

Deterioration and Spontaneous Heating of Coal in Storage.—This was the subject of a paper presented by Messrs. Horace C. Porter and F. K. Ovitz at a recent joint meeting of the New York Section of the American Chemical Society, the American Electro-Chemical Society, and the Society of Chemical Industry, at New York. At the conclusion of the paper, the authors offered the following recommendations as being advisable precautions for safety in storing coal, whenever the adoption of them did not involve unreasonable expenditure: (1) Do not pile more than 12 feet deep, nor so that any point in the interior will be upwards of 10 feet from an air-cooled surface. (2) If possible, store only lump. (3) Keep dust out as much as possible; therefore reduce the handling to a minimum. (4) Pile so that lump and fine are distributed as evenly as possible; not, as is often done, allowing lumps to roll down from a peak and form air passages at the bottom. (5) Rehandle and screen after two months. (6) Keep away external sources of heat, even though moderate in degree. (7) Allow six weeks' "seasoning" after mining before storing. (8) Avoid alternate wetting and drying. (9) Avoid admission of air to the interior of the pile through interstices around foreign objects, such as timbers or irregular brickwork; also through porous bottoms, such as coarse cinders. (10) Do not try to ventilate by pipes, as more harm than good is often done.

THE WELSBACH RANGE OF CAPABILITY.

High-Power High-Pressure and Low-Pressure Lighting—The Welsbach-Kern Radiator.

If one wants a 4500 or a 20 candle power light in a single unit, or anything intermediate, or if the ratepayers of a town desire the whole of their streets illuminated by gas in an up-to-date manner, or a private individual desires a single upright or inverted incandescent burner, the Welsbach Light Company, Limited, are prepared to meet the demand. This indicates a large range of capability; and we are satisfied, after a visit to the show-rooms and lamp-testing rooms at Welsbach House in the Gray's Inn Road, that in every respect the Company are well equipped to fulfil, with high efficiency lamps of excellent qualities in construction, any lighting commissions with which they are entrusted.

A High-Pressure Department.

The Company have added to their business a high-pressure department, in connection with which they have an expert staff. The lamp that has been adopted for this business is the Pharos; and it will be known as the Pharos-Welsbach. It is not the old Pharos lamp; the various types of the lamps which we saw running in the testing-rooms, and three samples of which, suspended in front of Welsbach House, are quite a feature of Gray's Inn Road at night time, have been improved to a degree that makes them altogether different from their precursors. We knew the old lamps, and we know the new; and the large stride that has been made between the one and the other is, to say the least, remarkable, though the earlier forms, in their day, were regarded as exemplifying the high efficiency possible with gas lighting.

Although the lamp then stood so high in illuminating merit, it was at the same time considered unfortunate that the shape was not more attractive. But for a period it was the mistaken belief that, if the shape were improved, the efficiency would be diminished—through the preheating of the air becoming irregular, and through an interference with the escape of the products of combustion. The contrary, as is seen, has proved true. With improvements made to increase its attractiveness, instead of the value of the lamp having depreciated, it has been much enhanced. The illustration accompanying this article, we are afraid, conveys but indifferently an idea of the general appearance of the lamp.

"Pharos-Welsbach" High-Pressure Lamp.

As is well known, under the Pharos system, either the gas or the air can be placed under high pressure; and, with either method, very severe tests, we are assured, have proved that an efficiency of 60 candles per cubic foot of gas are obtainable and maintainable, and still better results have been realized by those recognized illumination experts, Dr. Drehschmidt, Dr. Wedding, and Dr. Lux.

One of the principal points that has been overcome in both the Pharos high-pressure gas and the high-pressure air systems is the regulation of the air and the gas. Only primary air is used, the cooling action on the flame by cold secondary air is avoided, as well as an excessive temperature of the mixing-tube. In the high-pressure gas-lamps, the primary air enters just above the reflector, and passes through a ribbed inner chamber to the nipple, through which the gas is forced into the mixing-chamber. The air in its travel to the point of mixing is thus preheated by the products of combustion flowing up the exterior surface of the ribbed chamber; the air being governed at the nipple by a regulating-screw, which can be manipulated from outside the lamp. The entrance to the air-channel is provided with a dust-trap, in order to avoid dust particles entering the mixing chamber. The great advantage of this lamp over the old type, which had the gas-tubes outside, will be immediately appreciated. The nozzles of the lamp are made of a special metal, which is capable of resisting very high temperature, and in which the gas-ways are drilled in a special manner. The mantles are fixed on metallic carriers, which in turn are supported on the nozzles of the burners.

The old automatic distance-lighter has also undergone several improvements; the working having been made perfectly safe, and capable of giving thorough reliability in the operation of the pilot flame. A bye-pass screw is also provided, so that, should the automatic distance-lighter fail, by opening the screw the gas can be bye-passed. The lamps are designed for 54-inch to 90-inch pressure as desired.

The high-pressure air system has been favoured on the Continent; and we hope to be able to treat of this more fully in a future issue of the "Journal," as there is interest in it for all concerned in gas lighting.

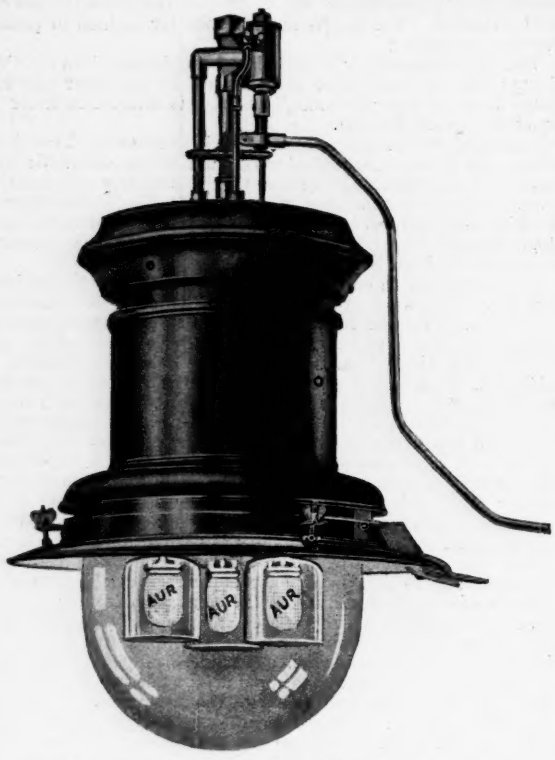
In regard to the gas-compressors, improvements have been made; one being a simplified regulation of the automatic bye-pass, for the purpose of maintaining the pressure at a constant level. We are informed that, though hundreds of installations of the Pharos system have been made in all parts of the world, not a single complaint has been received in respect of the compressors; so that this in itself is proof of entire satisfaction.

A disadvantage in connection with automatic control has been that all the lamps are extinguished at the same time, whereas, in many cases, it may be desired that only a certain number shall be extinguished at a fixed hour. This has now been remedied; and it is possible where Pharos high-pressure lights are installed to extinguish the required number, leaving the remainder burning. For instance, in a street in which the lamps are installed, it is now possible, by means of a simple automatic switch apparatus, to extinguish two lamps out of three. In the ordinary way, where the lamps have no special switch apparatus, they must be provided with levers, in order to cut them off from the high-pressure supply; but if this is done, manual labour is required, which, of course, is a disadvantage. Through the specially designed apparatus fitted to the lamps which it is desired to extinguish at a certain hour, no difficulty arises. By increasing the pressure on the compressor (which is very easy as the regulator is outside), a pressure wave is produced above the constant pressure; and the lamps fitted with the apparatus are extinguished by the pressure-wave action in the automatic part of the apparatus cutting off the supply, while the other lamps remain burning. A two-burner lamp can be provided with one apparatus; while in a three-burner lamp, two burners are provided with the apparatus. Therefore, in a three-burner lamp, two burners can be extinguished where desired at the same time from the compressor station. This means a saving of manual labour. There is also an economy in mantles, as they meet with no rough treatment. There is no cost for cocks and levers or their maintenance; and last, but by no means least, the item of unaccounted-for gas is not swollen as is the case where manual labour is employed for lighting and extinguishing the lamps.

As already mentioned, we saw these Pharos-Welsbach lamps running in the various sizes; and they were giving a penetrating, steady light. The 4500-candle power lamps are fitted with three burners; the 1000 and 1500 candle power sizes with single burners; and intermediate sizes with two burners. Soft mantles are used with them. A very good character is given to the lamps in respect of both globe and mantle maintenance.

High-Power Low-Pressure Lamps.

The Company have a good choice of outdoor and indoor lamps of high power for working on low pressures. Take first the excellent samples of exterior lamps, as found in No. 627 D. Associated with this number are two types of lamps, which, there is photometric proof, give an efficiency to the user of about 40 candles per cubic foot of gas consumed. They are strongly built lamps, with all parts interchangeable; and, in running, they are economical. There are three sizes of type 1 of this particular lamp—300-candle power, with single burner, consuming 7½ cubic feet of gas per hour; 600-candle power, with two burners, consuming together 15 cubic feet of gas; and 1000-candle power, with three burners, consuming together 25 cubic feet of gas. Type 2 is only made in the 600 and 1000 candle power sizes; and the reason for this will be seen presently when explaining the difference between the two types. The overall length of the lamps is 2 ft. 10 in.; and the diameter of the reflector, 1 ft. 8 in. Type 1 lamp has a top lever for simple lighting and extinguishing; and, in this instance (contrary to the case with type 2), there is no midnight flame, nor is provision made for outside ignition. Each single burner of the lamp, however, has its separate gas and air adjustment. The lamps are fitted in the upper part with a collar in which are apertures; so that, by the movement of the collar, when it is required to adjust the burners, the opening can be brought to the positions wherein the gas and air regulators are exposed. Provision is also made for turning the lamps from the wind for adjustment, renewal purposes, cleaning, &c. In fact, it is clear from an examination of the lamps that everything has been done to make them popular from the point of view of facility, and low cost, in maintenance. In type No. 2, a side swing lever and midnight flame are provided, so that by simply pushing round the swing lever, one light only burns; the other two lights being extinguished. This is far preferable to the method of producing economy by extinguishing every other lamp—the result of the latter practice being that the stretches between the lighted lamps are so great that ugly black lengths of roadway, alternating with bright lengths near the lighted lamps, is the effect. This is obviated by the lamps fitted by partial midnight extinguishing. Should a bye-pass jet be accidentally extinguished, provision is made in these lamps for relighting from outside. This is particularly suitable for street lighting where it is desired to dispense with the bye-pass by shutting off the gas by means of a cock at the base of the standard, or for shop lighting where the gas is turned off at the meter every night. Another important thing, in the interests of economy, is



High-Power Low-Pressure Lamp (627), with Lever for Partial Extinguishing at Midnight.

that every lamp has only one permanent pilot flame; and the intermediate ignition is out of action while the lamp is burning. When lighting-up one of the large lamps, the lever is slightly turned; and this ignites the bye-passes of each burner from the permanent pilot flame. A further movement of the lever opens up the gas supply to the burners, and the lamps are at once lit up. We get variations of these lamps in No. 627 C of type 2, and No. 627 B of type 1. The former is a lamp of three burners, giving together 600-candle power, fitted with side lever; and the latter a single-burner lamp with top lever. These are very smart looking lamps, and of somewhat smaller dimensions than the two types of No. 627 D.

A number of the various lamps were seen alight; and they were giving an excellent account of themselves. It is understood that the 1000-candle power form is most popular for shop-lighting; and small wonder when the gas consumed, at 2s. 6d. per 1000 cubic feet, only represents ¾d. per hour, while with an ordinary 1000-candle power electric flame arc lamp using 500 watts an hour, at 4d. per unit, the cost for energy alone is 2d. an hour, and besides the cost of the replacement of carbons is much greater than the cost of replacing gas mantles. If we take the lower efficiency metallic filament lamps, the difference in cost is still more marked.

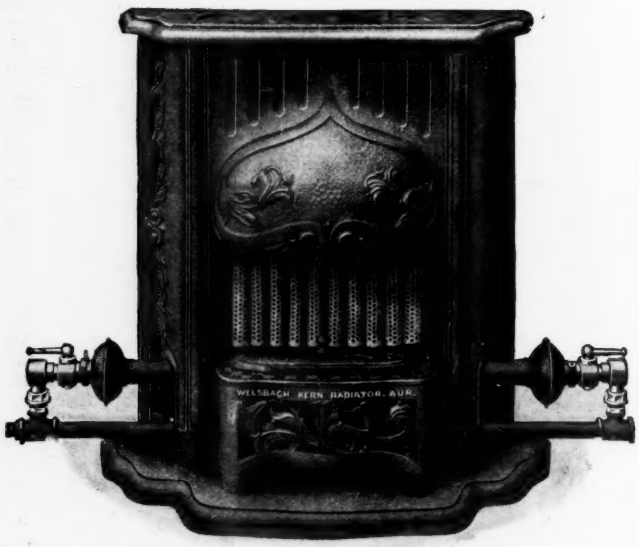
We have only dealt here with high-power low-pressure exterior lamps; but the Company have various forms of high efficiency lamps specially constructed for indoor use. We may mention, as examples, Nos. 623 and 624, which have been considerably improved in every vital part. The lamp has a heavy durable casing, the burners are detachable, and the regulator has been shortened and improved. This lamp has also a movable collar, with openings, for the purpose of obtaining access to the regulators, and to safely enclose them, and render them proof against dust and draughts, at all times when attention is not being given to the burners. A good selection of self-intensifying lamps was likewise seen; and, as a matter of fact, the Company have never been in possession of such a range of lamps for every purpose as they have to-day.

Domestic and Other Fittings.

It is impossible to note here the multifarious gas-fittings and requisites for lighting seen at the Welsbach Company's show-rooms. Enough has been said of lanterns for street and shop lighting; and, on the domestic side, fittings and glassware for both inverted and upright burners have a very considerable range, from the plain factory light to exquisite designs for the drawing-room. There is a great deal in obtaining the ultimate satisfaction of the consumer on the point as to the suitability of fitting to purpose. The Company find, in their dealings with the public, that there has been a rapid growth of demand for the decorative in connection with the various sizes of domestic inverted gas-burners—for decorative fittings and glassware, and the pretty beaded shades with which many ladies like to robe the globes, at the expense of lighting efficiency, but which do indeed give to them an artistic appearance. The range of choice is considerable. Speaking of inverted fittings, mention ought to be made of the "Premier" woven inverted mantle. This is securing a large patronage. It is of a finer mesh than its predecessors. With a mantle of the same outside dimensions as the old form, there is, with the closer impregnated mesh, naturally a larger area of incandescent surface. So that for this mantle a higher candle power is claimed than for the coarser mesh mantle, though the consumption of gas is the same; and, upon these advantages, is the claim that a closer mesh means enhanced structural strength.

The Welsbach-Kern Radiators.

As in lighting, so in heating. The Company have largely extended the range of their radiators, which have a choice, refined appearance, and give an excellent return in radiant heat efficiency for the gas expenditure. When it is said that the Company have no less than 37 models, each of which can be supplied in about twenty different enamelled colours, it is clear that the most fastidious taste for ornamental heaters can be satisfied from this considerable range. And as to efficiency. The Welsbach-Kern burner is used in these radiators; and each burner has a perforated clay tube above it, much in the form of a parallel mantle. With this burner complete combustion is secured; and the means of regulation are so handy and easy there is no excuse for a fire being noisy, or for the gas and air mixture being disproportionate for the realizing of the best results. Each fire is fitted with a patent combination gas-tap and adjustable nipple; and the adjustment responds at once to its operation, and gives the desired effect.



New Design in Welsbach-Kern Radiators.

The stoves are constructed for maximum consumptions of 10, 20, and 40 cubic feet per hour; so that they are of a power suitable for any dimensioned apartment. The larger sizes of stove have a tap on each side, to enable one-half of the burner to be extinguished when the room is sufficiently warm. There is by this means no lessening of efficiency, as is the case when one tap controls the whole of the burners, and is simply lowered—thus altering the ratio of gas to air, and destroying the conditions contributing to the highest efficiency. There is absolutely no smell from a properly adjusted Welsbach-Kern radiator. The small portable radiators are attractive, and very cosy looking for the heating of small rooms, such as bedrooms; and the consumption is so low that 1d. will cover the cost of fuel (at 2s. 6d. per 1000 cubic feet) for three hours or more. One of the modern designs of the radiator is illustrated.

The "Universal" steamless radiator is an effective heater for places where no flue is available—such as large workrooms, shops, halls, &c. The principles of this radiator are that gas and air are taken into the burner at the centre—thus ensuring equal pressure and perfect mixing. Cold air is drawn in at the point of ignition all round the heat chamber. The hot air is then filtered in tubes, through zig-zag plates, and a fine sieve, and is then discharged through slots underneath the top plate. The burner is fitted with a three-way tap, made to shut-down the consumption to about one-half when required. These radiators are built with four or six tubes—the consumption being in the case of the smaller size 8 cubic feet per hour at a pressure of 15-10ths, and with the large size 12 cubic feet per hour.

Many other interesting productions to which the Welsbach Company's name is attached were seen at their show-rooms; but with these notes, principally on some of the salient features of the newer additions, sufficient has been said to show the extensive and varied character of the Company's capability for meeting requirements, especially in the lines of gas lighting wherever they are laid, and whatever the purpose.

GAS BILLS FOR 1912.

[Third Article.]

Continuing the survey of the Bills promoted by existing statutory gas companies, we find there are six more in this group to be dealt with.

The first is the measure of the South Suburban Gas Company, the outstanding feature of which is the proposal to amalgamate with its own undertaking the concerns of the Bromley and Crays and the West Kent Gas Companies. Most of the details of the measure were noticed in the "Journal" for Dec. 26, p. 923; and therefore there is no necessity to again traverse the provisions so far as they were then treated. There is, however, some interesting information in the preamble, which shows the importance of the fusion of interests now in contemplation. The issued capital of the South Suburban Company consists of £60,000 of 5 per cent. preference stock and £605,000 of ordinary stock. The Company have also created and issued 5 per cent. debenture stock to the nominal amount of £117,058, and have received upon the issue thereof premiums amounting to £32,942. The issued capital of the Bromley Company now consists of £109,000 of "A" ordinary stock, £165,700 of "B" ordinary stock, and £82,278 of "C" ordinary stock. The Company have raised by mortgage of their undertaking £1500, and issued debenture stock to the nominal amount in all of £70,000. Regarding the West Kent Company, the issued capital consists of £50,000 in £10 original shares, and £25,000 of additional £10 shares, partly fully paid and partly with £6 paid up. The purchase of the two undertakings is on agreed terms, as set out in the notice above referred to. The provisions of the South Suburban Acts it is proposed shall apply to the districts of the Bromley and West Kent Companies; but there is reservation as to provisions in the Acts of the Companies that will remain valuable—being continued and extended to the South Suburban area. The promoters ask for sanction to the exercise by them of any unexhausted capital powers of the two Companies; any such issue of additional capital to be consolidated with the ordinary stock of the South Suburban Company. As mentioned when the Bill was previously under notice, the Chairman of the Bromley Company (Mr. Alexander Dickson) is to join the Board of the South Suburban Company from the date of transfer; and he is to continue (unless he desires to retire) a Director for two years from the date of transfer. For that term the number of Directors of the Board, it is suggested, shall be increased to seven, provided that the Company shall not be obliged during the period named to fill any vacancy that may occur in the number of the Directors, so long as there shall continue to be not less than five Directors, exclusive of Mr. Dickson. The remuneration of Mr. Dickson is to be at the rate of £300 per annum; but he is not to participate in any remuneration payable to the Directors pursuant to any resolution of the Company passed and in force. The proposed scale of compensation to the Directors and Auditors of the Bromley and West Kent Companies was dealt with in the notice already alluded to. Regarding officers not taken over, and who may be entitled to compensation for loss of office, it is to be an amount not less than the amount which under the Acts and rules relating to the Civil Service is paid to a person on abolition of office, as may be agreed upon between the South Suburban Company and the officer concerned, or, in default of agreement, as may be determined by an arbitrator. The reserve funds of the Bromley and West Kent Companies are to be added to the reserve of the South Suburban Company. The questions of the price of gas in the annexed areas, and the extension of the limits of supply, were dealt with in the reference to the Bill on Dec. 26. The South Suburban Company are asking for the old 10 and 15 per cent. discounts clause, instead of the simplified alteration of section 13 of the Gas-Works Clauses Act of 1847, as provided in the Model Clauses. There may be some special reason for this; but the discounts clause in the form in which it appears in the Bill is a rarity in current legislation. Power is taken to create a special purposes fund. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Swanage Gas and Water Company are asking for powers in relation to both their undertakings; but we will confine ourselves in this notice to the gas section of the measure. It is gathered from the preamble that the capital, under the Company's 1901 Act, relating to the gas undertaking is £35,600. The clauses in which the gas undertaking is concerned are few. It is proposed to repeal the standard burner section of the Act of 1901; and to prescribe the use of the "Metropolitan" burner No. 2, and a standard illuminating power of 14 candles. Among other desired powers of now ordinary character, is one to create a special purposes fund. A stand-by clause covering both private gas plants and electricity installations appears; and the Company ask to be exempt from penalty for refusing to supply anyone using such a gas plant, if such supply would jeopardize the supply of gas for public or private lighting. The capital powers required refer to the water undertaking, and will be dealt with when noticing the water section of the measure. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

The Tendring Hundred Water and Gas Company are promoting a Bill, the greater part of which relates to the water undertaking, and therefore few lines will suffice for the gas section. Authorization is sought to the extension of the limits of the gas-supply area to the parishes of Weeley, Thorpe-le-Soken, Kirby, Little Clacton, Great Holland, and Little Holland. The Company desire the repeal of the testing section of their Provisional Order of 1878 so far as it alludes to the standard burner, in place of which they wish to have set up the "Metropolitan" No. 2 burner. The prepayment meter and other clauses are of "model" terms. Referring to both gas and electricity, a stand-by clause is included. The capital does not appear to be divided as between the gas and water undertakings; and the Company are asking for authorization to the raising of an additional £120,000, by the creation and issue of new class "A" or "B" shares, or wholly or partly by either of these methods. A maximum dividend of 8 per cent. is proposed. Borrowing powers are sought to the extent of one-third of the issued additional capital. Power to grant pensions and other allowances is asked, as well as authority to determine the remuneration of the Secretary. One at least of the auditors in future is to be a member of the Institute of Chartered Accountants or of the Society of Incorporated Accountants and Auditors. [*Parliamentary Agents: Messrs. Rees and Freres.*]

A Bill promoted by the Wakefield Gas Company next falls for notice. The statement of the existing position of the capital appears in the preamble. Under the Act of 1847, £25,000, in £25 shares, was raised, being entitled to dividend at the rate of 10 per cent. per annum. Under the same Act, £18,300 was raised by the issue of £5 shares, entitled to a dividend of 10 per cent. per annum. Under the Act of 1856, £36,700 was raised in £5 shares; these being entitled to a dividend at the rate of 7½ per cent. per annum. Under the Act of 1877, £50,000 was raised in £10 shares; these carrying dividend at the rate of 7 per cent. per annum. Under the same Act, £20,000 was raised as preference stock, bearing dividend of 4½ per cent. per annum. The whole of this capital is paid up; and the Company have now unexercised capital powers to the amount of £5000. On the shares and stock issued under the Act of 1877, premiums were received to the amount of £13,074 17s. 9d. Under the Act, the Company were authorized to borrow on mortgage up to £18,700. They have borrowed, by the creation and issue of mortgage bonds now outstanding, £11,500, entitled to interest at rates varying from 3½ to 4 per cent. per annum. It is now proposed that the limits of supply shall be extended so as to include the parish of Crofton, the townships of Walton, Chevet Woolley, Bretton West, and Wintersett, and parts of the townships of Notton and Crigglestone. The repeal of an agreement, made on Nov. 6, 1908, between the Company and the parish of Notton is sought; and in reference to the portion of Crigglestone that it is now desired to embrace in the limits of supply (within part of which the Company have been supplying gas since 1883), it is proposed to extinguish the unexercised rights of the Ossett Corporation to supply within the district in question as conferred by their Act of 1900. Manufacturing powers are requested in relation to a piece of land, measuring 14,357 square yards, now in the possession of the Company; and, in conjunction therewith, authorization is required to construct a new footpath and to stop up an existing one. The Company seek powers to convert the ordinary shares into two classes of stock, to be called ordinary stock and five per cent. maximum stock. These stocks will be distributed among the holders of shares in the following manner: For every existing share of £25 each, entitled to a dividend of 10 per cent. per annum, £25 of ordinary stock and £25 of 5 per cent. maximum stock; for every share of £5 each, entitled to a dividend of 10 per cent. per annum, £5 of ordinary stock and £5 of 5 per cent. maximum stock; for every share of £5 each entitled to a dividend of 7½ per cent., £5 of ordinary stock and £2 10s. of 5 per cent. maximum stock; and for every share of £10 each, entitled to a dividend of 7 per cent. per annum, £10 of ordinary stock and £4 of 5 per cent. maximum stock. To this end, it is proposed to create the nominal amount of £130,000 of ordinary stock, and £81,650 of 5 per cent. maximum stock. Any remaining capital powers under the Act of 1877 are only to be exercised, after Jan. 1 next, by the creation of preference stock. Additional capital powers are asked to the amount of £120,000 of 5 per cent. maximum stock or new preference stock, or partially by one or other of these modes. In respect of the additional capital, authority is asked to borrow up to one-third part. Relating to administration, a Managing-Director clause is included, as also is one giving the Directors the right to determine the salary of the Secretary, while another provides for professional accountants as auditors. It is proposed that the sliding-scale terms be altered by prescribing variations of dividend at the rate of 5s. per cent. for penny changes in price. Power is to be taken to create a special purposes fund. The promoters suggest that the prescribed illuminating power shall be 13 candles, tested by the "Metropolitan" No. 2 burner. A stand-by clause is inserted relating to both gas and electricity. In the prepayment meter clause, the Company seek a variation from the model by specifying 8d. for a meter without fittings. A clause asks for authority to make superannuation and other allowances; and the Company propose that they be invested with the power to put into force a profit-sharing scheme. [*Parliamentary Agents: Messrs. Torr and Co.*]

The Bill of the Wandsworth and Putney Gas Company proposes a plain and simple amalgamation with the Mitcham and Wimbledon Gas Company and the Epsom and Ewell Gas Company. The existing capital (in various classes, and including premiums) of the Wandsworth Company amount to £467,766, and the loan capital to £80,496. Including premiums, the ordinary stock of the Wimbledon Company amounts to £355,594; and the debenture bonds issued represent £60,000. The Epsom Company

have ordinary stock amounting, with premiums, to £99,819, and debentures totalling to £15,000. Of the authorized ordinary capital respectively of the amalgamated companies, there remain to be issued sums amounting in the aggregate to £439,292—*i.e.*, of the authorized capital of the Wandsworth Company, £181,402 of 3½ per cent. stock; of the authorized capital of the Wimbledon Company, £197,709; and of the authorized capital of the Epsom Company, £60,180. It is proposed that this capital (defined as "unallocated capital") should be raised as 3½ per cent. stock. The clauses referring to the amalgamation follow; and as these were reviewed in our issue for Dec. 26, p. 923, the particulars need not be repeated here. It was mentioned in that notice that there were special provisions relating to the testing of gas. These only refer to testing for information in the Wandsworth district, for calorific power, sulphur other than sulphuretted hydrogen, and illuminating power by means of a flat-flame burner; and in the Wimbledon area, for calorific power, and for illuminating power by means of a flat-flame and an incandescent burner. At Epsom, the Company are "to maintain, to the satisfaction of the surveyor of the local authority, the tanks now erected in connection with such works in which all liquor resulting in or from the manufacture of gas or other product shall be collected and treated, so that it shall be rendered harmless to the material of which the sewers and sewage collecting tanks of the local authority are constructed, and to the land on the sewage farm and the bacteria beds and works thereon. [*Parliamentary Agents: Messrs. R. W. Cooper and Sons.*]

The York United Gaslight Company have a Bill for several purposes—to consolidate their Special Acts, to extend the limits of supply, to authorize the construction of additional works, to raise additional capital, to change the name of the Company, and for other purposes. The capital of the Company at present consists of £370,000 consolidated ordinary stock, entitled to a uniform maximum rate of dividend of 4 per cent. per annum, £50,000 preference stock, entitled to a dividend of 4 per cent., £10,000 authorized by special resolution of the Company to be issued, but not yet issued, and £374 representing premiums. Debenture stock has also been issued to the amount of £35,000, bearing interest at the rate of 3¾ per cent.; and there are unexhausted borrowing powers to the amount of £5000. A considerable extension of the limits of supply is proposed; and as to capital, it is contemplated that it shall be £500,374 10s., of which £80,000 is additional capital. The £10,000 created under the Act of 1898, but not issued, is to be cancelled. The Company ask for borrowing powers in respect of the capital raised to the amount of (including the £35,000 already borrowed) not exceeding £50,000, and up to one-third in relation to the additional capital. The Company desire power to create reserve and special purposes funds. Professional auditors are arranged for. Further land is scheduled for new works. It is proposed that the standard price within a radius of two miles from the centre of Ouse Bridge in the city, and such parts of the city as at present extend beyond that area, shall be 2s. 10d., with the sliding-scale operating by 5s. per cent. on account of dividend for 1d. reductions or increases of price as the case may be. In the outer area, the Company are not to charge more than 6d. beyond the price within the inner area. Until the 1st of January, 1913, the price charged by the Company to persons burning gas by meter is not to exceed 3s. 6d. per 1000 cubic feet in the inner area, and 4s. in the outer area. The following are interesting clauses, relating to the recovery of money due, and to people interrupting the workmen in the discharge of their duties:

> If any person liable to pay any gas or meter rent shall at any time begin to remove his goods or furniture from the house or premises in his occupation, or to sell or dispose of, or carry away, his goods or furniture without paying all arrears then due in respect of such house or premises by virtue of this Act, then, in addition to the remedies hereinbefore given, and either before or after resorting to the same, it shall be lawful for any collector for the time being of the Company to collect and levy such rents and all arrears which shall be then due thereon by distress and sale of the goods and chattels of the party so beginning to remove, sell, or take away any such goods or furniture as aforesaid; and if within five days next after such distress shall be made, the said rents and all arrears due thereon, together with the reasonable charges of taking and keeping the said distress shall not be paid, the said collector shall cause the said goods and chattels to be appraised and sold, or such part thereof as shall be sufficient to pay such rents, together with all arrears due thereon and the reasonable charges of making such distress and of keeping and selling the same, returning the overplus (if any) to the owner of such goods and chattels respectively.
>
> If any person shall wantonly or maliciously hinder or interrupt the Company, or their deputies, agents, workmen, or servants or any of them in doing and performing any of the works or in exercise of any of the powers and authorities by this Act granted, or shall in anywise cause or procure the same to be done, every person so offending shall for every such offence forfeit and pay to the Company any sum not exceeding £5, and also the full amount of the damage which shall be sustained by such hindrance or interruption.

The prescribed standard illuminating power of the gas, it is suggested, shall be 14 candles, tested by the "Metropolitan" No. 2 burner. A stand-by clause is included referable to both gas and electricity. Power to grant pensions, &c., is desired. If the measure passes, the Company will be known thereafter simply as the York Gas Company. [*Parliamentary Agents: Messrs. Durnford and Co.*]

GAS-FIRE CONSTRUCTION

FROM ANOTHER POINT OF VIEW.

By Thomas Glover, of London.

Two exceedingly interesting articles on the above subject have already appeared in the "Journal"—Oct. 24 last, p. 241, and Jan. 16, p. 149—from the able pen of Mr. H. James Yates, F.C.S., M.I.Mech.E.; and, owing to the publicity given to them in the columns of this paper, they have without doubt been widely read and appreciated. Although the present writer is not so prominently before the public, nor possesses the same literary ability as the writer of the articles mentioned, yet he feels that there are many points raised in these articles which could be beneficially discussed much further.

At the outset, he would like to express the highest possible admiration for the author of the articles, and his keen appreciation of the exceedingly ingenious way in which incorrect conclusions have been drawn from scientific data; dogma being deduced and insisted on in a somewhat arbitrary fashion. The present writer has for several years past been investigating the problems relating to gas-fire construction—in the first instance simply for the sake of the knowledge itself, but latterly, like the author already mentioned, with a view to improving some gas-fires actually before the public. Consequently, like Mr. Yates, he cannot approach the subject without making statements appearing to bear too directly on some particular fires which embody the results of his scientific researches.

In the present article, it is proposed to follow as closely as possible the outline of the article published on Jan. 16, and to endeavour to show that no one type of gas-fire construction is the only possible form from every point of view. Empirical results derived from the testing of any one type of construction must not be dogmatically applied piecemeal to other types of construction. The two former articles present very exhaustively and clearly the principles underlying the construction of a particular type of fire which was introduced some years ago, and is now scarcely modern; and the arguments put forward are based upon, and the conclusions are deduced from, the state of knowledge two or three years ago. While the statements about to be put forward can be scientifically substantiated for the constructions considered, new methods—whether of construction or of combustion—may at any time call for a fundamental revision. Experience has shown over and over again, and is doing so at the present time in the gas industry, that no one is justified in dogmatically taking one's stand on the state of knowledge in one's own time, and totally ignoring the possibilities of further research. Even data, to-day appearing to be sound and trustworthy, may, in the near future, be absolutely falsified.

Functions of the Brick.

In the former article, the most important function of the brick in the ideal fire there taken, and in nine out of every ten fires now before the public, is entirely omitted. The brick is, in fact, the principal radiating material. It is, therefore, illogical to apply the word "radiant" solely to the fire-clay envelopes for the flames, generally called "fuel." The fuel undoubtedly serves to raise the temperature of the flame, and being light in structure, becomes incandescent, and consequently pleasing to the eye. It looks warm. The brick, however, becomes red hot, and is the true "radiant." So it may with equal truth be stated that the fuel "acts as a protector," and keeps the radiant brick "from too rapid cooling." This important function of the brick is carried to its extreme limit in patent No. 493 of 1910, taken out by the author of the two preceding articles. An abstract of the specification of this patent will be found on p. 861 of the "Journal" for Dec. 20, 1910. The method there outlined was tested very thoroughly several years ago by the present writer and discarded; but then, of course, it was pointed out in the preceding article that this method has had to be abandoned in the latest fires.

A further proof of the foregoing is furnished by the fact that no secondary air is allowed access to the back of the fuel except by passage through the fuel (1) by the space left around the burner nozzles, or (2) through the comparatively large apertures in the front of the fuel. The amount drawn through (1) is the smaller proportion. In these types of fire the flames do leave the fuel through the back section; and "the portion which thus burns outside the radiants does nothing to increase the incandescence of the fire, and a lowered efficiency is the result. At the same time, the incomplete combustion inside the radiants causes deposition of carbon there, to say nothing of probable production of carbon monoxide." This is, however, not the case when the back of the fuel is made the radiating medium, in which the apertures conduct the "considerable secondary air supply to complete the combustion of the gas" into the fuel, and thus surround the flame with secondary air, obviating all possibility of its "floating" either through the front or the back of the fuel.

Fuel which is light in structure, of course, quickly gets incandescent; but, as already pointed out, owing to the smallness of the bulk, it is necessary to rely upon the brick for the heat radiated. A further disadvantage of such fuel is its exceedingly fragile nature, which makes it costly from a maintenance standpoint, and often dangerous; and it is satisfactory to observe that some very

light fuels of preceding years have been strengthened—thus reducing maintenance cost and danger, although detracting somewhat from the appearance of the fire.

The question of temperature and its relation to radiation, according to the Stefan-Bolzmann law, raises an interesting point. The lower the temperature at which the heat can be radiated into a room, without sacrificing any of the radiant efficiency of the fire, the more comfortably and hygienically will the room be heated. Although the air is not heated by the passage through it of radiant heat, the particles of dust, and of organic and inorganic matter, do not so easily escape. Such considerations have led to the abandonment of high-temperature convection, and they should also be remembered in connection with this high incandescence or high-temperature radiation. To give a parallel case, gas engineers point out that an incandescent mantle gives more useful light than an arc lamp, because the source of light is distributed in the former case and concentrated in the latter. Exactly the same commonsense reasoning applies to heating mediums.

That low temperature radiation can be obtained by proper construction, and be made at least as efficient as high-temperature radiation, is not theoretical only; actual fires are before the public, and are recognized widely. In fact, what is usually claimed to be high-temperature radiation is almost always composed of a small proportion of true high temperature radiation from a very light, open fuel, and a large proportion of low-temperature radiation from the large area of brick showing behind and above the fuel. This introduces the question of length of fuel. The larger the area of the fuel, the lower will be the average temperature of the heat radiated; but, owing to the large area, it has been found that there is no lowering of radiant efficiency. If, however, a short, light fuel is used, then "the products of combustion leave them at a higher temperature," so carrying away heat; and if this heat were not trapped before reaching the flue, and turned into low-temperature radiation, the efficiency of the fire would be seriously reduced. All this is, of course, faithfully indicated in the former article; but it is not shown why a large surface of curved brick employed for this purpose is no "waste of material," whereas a slight lengthening of a relatively light fuel is a "waste of material." It would appear that the choice is merely a question of artistic taste. But there is one other point which must decide. Does either method prevent free access of these hot products of combustion (when deprived of the desired heat) to the flue?

The maximum percentage of heat radiated by a fire is not a subject upon which dictum can be laid down. Science most certainly does not declare "that something in the region of 50 per cent. is the highest percentage of the heat units obtainable as radiation." It does, however, most emphatically declare this to be the case with many gas-fires available to the public. But there are fires available in the show-rooms of many gas companies which give higher radiant efficiency. Only suggestions as to maximum percentage ever obtainable can be made as a result of any individual's experience.

As to the size of the flue outlet, it can be shown that for a fire burning 25 cubic feet of gas, a flue outlet of 5 square inches is ample, provided the products of combustion are delivered into the canopy of the flue opening. Should the construction of the fire be such that, owing to diffusion of the burnt gases, the products have to be collected from a much larger area, an excessive draught has to be put upon the fire to try and pull back some of the products which have escaped, and a flue area of double the size is unavoidable. The flue also has to be of abnormal shape to get a pull on the fire, owing to the fuel projecting and the brick obstructing the free passage of the products of combustion which otherwise would be sent into the room.

Abnormally projecting canopies are another endeavour to collect these products; and it can be laid down as a rule that the more the fuel projects from the body of the fire, and the greater the gap between the top of the fuel and the canopy, the greater will be the proportion of products sent into the room. And, as indicated in the article, it is therefore necessary to let the canopy project in front of the perpendicular drawn through the centres of the burner nozzles. There has been a notable instance of this objection in a series of fires with a beautiful design put on the market this season. This series has had to be withdrawn, owing to the flue outlet being no less than 8 inches from the top of the fuel. It can be further stated (and proved) that fires with curved burners require even a greater canopy area than fires with straight burners.

With regard to the angle at which the fuel is laid, it is a demonstrable fact that partially burnt gases and the products of combustion will follow a hot surface, provided the temperature of the surface with which they are in contact is sufficiently high, and that diffusion is minimized. Therefore, if the fuel is sloped towards the flue and taken up into the canopy, no fumes will escape into the room. Nowhere in the course of the former article does the writer give any indication of the question of diffusion of the products of combustion—one of the most important subjects to be considered in gas-fire construction. The argument that, to ventilate a room, it is necessary to draw a considerable volume of air through the flue of a gas-fire, and consequently over the radiating material—whether the fuel or the brick—is unsound. Ample air can be extracted from the room using the gas-fire as the means of warming the chimney; but, instead of conducting the air through the canopy of the gas-fire, it is very much preferable to stand the fire so that there is a space between the fire and the mantel opening, to allow a considerable amount of air over a large surface and at a low rate of flow to be drawn up the chimney behind the fire instead of through the canopy. It is, therefore, possible with long fuel to have an extended area available for radiation without cooling-down the fuel or brick.

It is not possible to lay down any law as to what importance should be attached to the appearance of a gas-fire from an æsthetic point of view, and what importance should be attached to efficiency. In the opinion of the writer, canopies which are fitted with bricks to hold the fuel in position do not and cannot obstruct the free passage of the products of combustion as much as a brick which has a projection over the top of the fuel. A direct contradiction can be given to the opinion expressed in the statement that fuel "unless they are so wide as to be useless, the cross sectional area cannot be great enough to contain the products of combustion and not allow any to escape, especially if such radiants are shaped to fit the flame as it tapers towards the top." With an efficient draught, the products pass through the fuel to the flue in a well-designed fire, following the hot surface, as indicated in the preceding paragraph. Fuel sloping back is—apart from the question of being better in appearance—more effective because the direction of radiation is slightly inclined upwards from the floor instead of being perfectly horizontal. In other words, it is better to gently warm the walls of a room than to scorch the carpet.

In conclusion, it may be again mentioned that, while the points emphasized by Mr. Yates in his exceedingly interesting communication may be correct in their application to the type of fire which he had in mind when writing the article, it is entirely erroneous to apply them to a different and more advanced type.

THE EFFECTUAL WORKING OF A CARBURETTED WATER-GAS PLANT.

By Alwyne Meade, Assoc.M.Inst.C.E., F.C.S.

In gas-works in which there is a water-gas plant in addition to the ordinary coal-gas apparatus, it is generally to be found that the effective working of the latter, and the procuring of the present-day high makes, requires the greater part of the time at the disposal of those in charge, with the result that the water-gas plant rarely receives the share of attention it merits, and consequently its working is seldom, if ever, brought up to the highest degree of efficiency.

There is, of course, no question as to the much greater importance of the retort-house, and to its prior claims, and no one doubts that this is "the place in which the dividends are earned." But from the point of view of the water-gas plant, it is undoubtedly a mistake, when comparing the relative working of different undertakings, to consider, as is very often the case, the coal-gas results alone, whereas the results of its important auxiliary are more or less ignored. A water-gas plant is capable of considerable extravagance when worked indifferently. On the other hand, very material savings can be realized by attending to minor details in connection with the routine work.

The writer has lately been connected with the working of two carburetting plants which were orginally constructed to produce 850,000 cubic feet per day. Recently, however, the 8 ft. 6 in. generators have been replaced by 9 ft. 6 in. ones (these are over-all outside dimensions); and the contractors guaranteed an additional make of 400,000 cubic feet of gas per plant per diem—bringing up the capacity of the plants to 1,250,000 cubic feet. Everything worked quite satisfactorily while the work was new, and the guaranteed quantity of gas was produced. But makes gradually fell away; the coke figures increased; and the oil consumption was unsatisfactory. Several reasons which might account for this gradual deterioration then occurred to the writer, and attention was given to the most minute details in connection with the working of the plants. The time thus spent has been amply repaid by the excellent results which are now being obtained.

Each plant is at present producing 1,500,000 cubic feet per day—and at times the make has reached nearly 1,600,000—or 250,000 cubic feet above the guaranteed quantity; the coke and oil figures have been considerably reduced; and the results are more satisfactory than at any previous time. The conclusion to be drawn is that the inefficient working of a water-gas plant is not the outcome of any one specific defect to which one can immediately turn and apply a remedy, but rather is it due to the combination of a number of small, but, nevertheless, significant, factors which, in the general course of events, are inclined to be overlooked. A great deal, of course, depends on the energy and intelligence of the head gas makers who operate the plant, but—*inter nos*—allowances must be made for the frailty of human nature, and, perhaps, such operators have neither sufficient zeal, nor the necessary authority to work out their own salvation, when they find that results are not up to the usual standard.

The first item to which attention was directed was that of increasing the daily output of the plants; and it has been found, contrary to the opinion of some authorities, that the most economical results are obtained, and the greatest yield of gas produced, when the steam on the up-run is regulated—by the Venturi steam-meters—to about 47 lbs. per minute, and on the down-run to about 49 lbs. per minute. The whole of the other results, such as the coke and oil used per 1000 cubic feet, must necessarily depend to

a very great extent upon the total make of gas; and it is found that little or no more coke is now being used for the additional 250,000 cubic feet of gas which is being obtained. This, of course, considerably helps to reduce the all-important figure of coke used per 1000 cubic feet.

Again, the amount of gas produced is greatly dependent on the total period of "running" which is obtained in the twenty-four hours. In this respect some considerable headway has been made; for at the time when the plants were working indifferently this total period of running averaged about 750 minutes, whereas it is now about 810 minutes—an increase of 60 minutes. When it is remembered that the mean make per minute is about 1900 cubic feet, it will be seen that this increased time of running accounts for an additional 114,000 cubic feet of gas during the twenty-four hours working.

The extra time was made up chiefly by altering the durations of the "runs" and "blows," and also by attending to the time taken in clinkering the generators. As regards the time taken by the latter operation, it should be pointed out that this originally took about 33 minutes to complete (this is the actual time between the end of the last "run" before the clinkering, and the beginning of the first "run" after clinkering); but it has now been reduced to an average time of about 25 minutes, and often only occupies 23 minutes. Thus the saving per clinker is 8 minutes, or the large saving of 48 minutes in twenty-four hours. This 48 minutes provides for six additional "runs," which means another 56,000 cubic feet of gas .

In going into the question of clinkering, it was found that one gang of men took on the average about 7 minutes longer to complete the work than the other gang. This was merely due to the fact that the inferior gang were going about their work in the wrong way; and on the methods of their fellow gang being adopted, the two times were almost equalized—in fact, there is now keen competition between the two shifts, and the writer does not forget to let them know every morning which of them won on the previous day.

From the preceding remarks, it will be noticed that the down-run steam is regulated so as to be rather greater than the base steam. This has been done for the purpose of driving the clinker well down, and causing it to form in as large lumps as possible. This considerably facilitates the work; for it is the small stray pieces which take time to remove. A rule has been made that no top steam shall be admitted for at least an hour before clinkering takes place. The down-run, of course, causes the base of the fuel-bed to become exceedingly hot; and this, again, is one of the influences which tends to increase the time of clinkering.

As regards the duration of "runs" and "blows," originally the system in use was a three minutes "blow" and a five minutes "run;" and after coking-up the generator the blowing period was increased to four minutes. The system now in use is a three minutes blow with a five minutes run; but the run immediately before coking-up is prolonged to six minutes. The fire is then exceedingly hot, and there appears to be a good yield of gas during the extra minute. The four minutes blow after coking is still retained. This cycle appears to work excellently, and has given better results than any other of the many cycles which were experimented with; moreover, in this way the total period of running is moderately high. A method of six minutes runs throughout was also tried; but the additional yield of gas during the last minute seemed to be very small, and the results were not nearly so satisfactory as those given by the above system. It is, of course, hardly necessary to mention that constant steam pressure at the boilers is essential; and it has been found that even a drop of from 3 to 5 lbs. per square inch has very telling effects upon the make of gas.

Coming to coke consumption, this is an item which, although of great consequence, is, at the same time, rather unsatisfactory to work upon; for in nearly all cases the coke taken to a water-gas plant is not weighed, but is merely estimated at so much per bunker. This method of estimating leaves much to be desired; and owing to the varying densities and conditions of different classes of coke, the estimated weights are almost sure to be somewhat wide of the mark. This is a matter which requires very careful attention; and it is an excellent plan to frequently check the weights, and notice to what extent they vary for the different classes of coke. In the case in question, there was reason to suppose that the quantity of coke used daily was excessive, and in weighing out sample bunkers it was found that on the average each one was being booked about 50 lbs. in excess of its actual net weight. Moreover, it transpired that during the night the bunkers were not filled to nearly the same extent as they were during the day, but the same standard allowance was still booked down to them.

The make of gas is unquestionably affected by the type of coal from which the coke is obtained; and whereas excellent results may be secured from the coke given by such coals as Boldon and Holmside, a difference is quickly noticed when the coke is the product of inferior coals such as Shotton and Horden. Over-quenched or damp coke is also to be avoided whenever possible, although some engineers have been known to say that practical results show the effect due to this to be very slight.

At the time when the plant was working at its worst, the coke used for 1000 cubic feet invariably reached a figure of 43 lbs.; but with the increased make of gas and other modifications, this has been reduced to just over 36 lbs. with the best coke, and seldom exceeds 37½ lbs. In order to find out roughly how much coke was actually used in the generators, the amount of pan-coke removed with the clinker was carefully collected, washed, and weighed, and by making allowance for this, the above figure is reduced to the small amount of 33 lbs. per 1000 cubic feet. As there is a good demand for pan-coke, there is no reason why the plant should not have the benefit of it, although, of course, its value, when washed, is only about half that of ordinary coke.

Conclusions.

In conclusion, it may be as well to tabulate the various points in connection with the working which have received attention, and of all of which, it is to be presumed, the excellent results are the outcome.

1—Increased length of "running" per 24 hours (sixty minutes gained).
2—Decreased period of clinkering, each period reduced by about seven minutes.
3—Alteration of system of "runs" and "blows," with six minutes run immediately before coking-up.
4—Amount of steam (pounds per minute) adjusted to give most economical and satisfactory results.
5—No "down-run" for an hour before clinkering.
6—Weights of coke bunkers regularly checked.
7—Blast reduced to 14 inches.

There is not the least doubt that a great acquisition to any water-gas plant is a Thorpe's automatic register; and it is probable that, owing to the absence of one of these, many a mysterious derangement of the night fails to reach the ears of unsuspecting officials.

As regards the use of pyrometers, it is the writer's opinion that they are really of very little assistance in furthering the working of the plant, and are chiefly of interest from the scientific point of view rather than from the practical standpoint. In the efficient working of a carburetted water-gas plant, it is generally found that the most valuable asset is a head gas-maker who has a thorough practical knowledge of his work, and can tell at once when the apparatus is out of condition, and when the temperatures of the various parts of the plant are below or above the normal. Beyond all, it is an excellent state of affairs when a certain spirit of rivalry exists between the gas makers working in the different shifts, especially when these men know that at headquarters much interest is being taken in their competition.

One great advantage about the working of a water-gas plant is that in each shift, the greater part of the labour devolves upon one man alone, and, when things are unsatisfactory, it is possible to go direct to the fountain head and demand the necessary explanations. Thus, from his own point of view, the water-gas operator really occupies a far more perilous position than his more fortunate colleague of the retort-house, who can take refuge under the plea that any irregularity was undoubtedly due to misbehaviour on the part of one of his numerous and promiscuous mates.

It should be mentioned that the illuminating power of the gas produced from the plants in question is maintained at about 20 candles; and the oil results are also extremely satisfactory. In a subsequent article, the writer hopes to deal more fully with these, and to dwell on points in connection with the effective carburetting of the gas.

Projected Exhibition of Street-Lamp Designs.

At the Architectural Association, on Monday last week, Mr. E. F. Strange, of the South Kensington Museum, delivered an address on Alfred Stevens, the designer of the Wellington Monument in St. Paul's Cathedral. In the course of it, he referred to the work done by Stevens in designing street-lamps, and said he did not think the designs had been brought very prominently before the public; but he hoped in the course of a few weeks to have a series of them exhibited in the Museum. He thought they ought to attract a certain amount of public attention. Stevens made a serious attempt to beautify street-lamps, and obviously studied proportion very carefully. He did not overload them with ornament, and, on the whole, seemed to have accepted the conventional form of having the lamp at the top of the post. Most of his attention was given—not unnaturally, and perhaps not unwisely—to what one saw when one walked along the street. He (Mr. Strange) thought the designs were very beautiful; and, so far as he was able to judge, there would be no difficulty in the execution of them. The one point of criticism which might be made against them was that towards the bottom the posts were not strong enough; but if there was any chance of the designs being carried out, this might be modified to some extent. Of course, in Stevens's day there were no motor omnibuses.

Reports of Gas Associations for 1911.—As announced in the "Journal" last week, this work is now ready. The volume contains the collected reports, as given in our columns, of the proceedings at the meetings of the various District Gas Associations held in the past year. The technical matter occupies 568 pages, and it is illustrated by 44 diagrams, &c., and three folding plates. Reference to any subject is facilitated by an index; and at the end of the book are given lists of the officers and members of the Associations. The volume, which is the twenty-ninth of the series, forms a useful companion to the "Transactions" of the Institution of Gas Engineers.

YORKSHIRE JUNIOR GAS ASSOCIATION.

On Saturday last, even the existence of exceptionally adverse climatic conditions did not prevent a large muster of members assembling at the Halifax Gas-Works on the occasion of the monthly meeting of the Yorkshire Junior Association. It took place in one of the workshops of the Lighting Department of the Corporation; and Mr. J. Pyrah, the Lighting Superintendent, gave an address on "Street Lighting," with special reference, of course, to local conditions and practice—his explanations being elucidated by reference to actual specimens of the lanterns, gas-burners, and other appliances fitted up and lit.

The Halifax Gas Committee make their own lanterns, and have developed some special features both in them and in the fittings and the arrangements of the burners. Samples of these in various stages of manufacture and the loose separate parts were on view, and were examined with interest. High-pressure lighting has not been adopted, and high-power units are not viewed with favour—at least by the Gas Department. The lamp used in the main thoroughfares is a hexagonal lantern with six upright burners arranged on a ring base. Its construction and special features were dealt with at length—notably those for securing economy in its maintenance. Each face is filled with two sheets of toughened glass; and, to avoid excessive breakage of mantles, the inner chimney is lowered over the burners and mantles when the lantern has to be cleaned. Various forms of clockwork automatic lighters were fitted on a demonstration bench; and the conditions under which their use would be locally advisable were discussed. The inverted burner has not yet been widely adopted in Halifax streets; but the various types tried were shown, and a home-made arrangement of three (one only remaining alight during the night), which represents the arrangement now viewed with most favour, came in for a good deal of examination and comment. Mr. Pyrah largely favours an acetylene torch for lamp-lighting; and his men are very decided in their preference for this type. The "climbing tube" ignition originally installed in the lamps is now gradually being superseded, with a view to the exclusive adoption of the acetylene torch. Incidentally, the question of pilot-lights came under review; and Mr. Pyrah expressed his strong preference for limiting their use as much as possible in the interests of economy.

At the close of the address, questions were asked and answered. Cordial thanks were awarded to Mr. Pyrah, whose handling of his theme with the ease that befits an expert at whose finger-ends are all the practical details of the work, gave much pleasure and profit to the audience.

An adjournment was then made for tea, which had been kindly provided by the President (Mr. C. D. Cawthra), the Assistant-Manager of the gas-works, who is now in charge until the new Engineer (Mr. M'Lusky) takes over his duties.

Subsequently Mr. CAWTHRA delivered the following

PRESIDENTIAL ADDRESS.

In acceding to the request that I should step into the breach caused by the resignation of the office by the two gentlemen who, in the ordinary course, would have occupied the chair before me as President of the Association during the current year, I have accepted the position without going through the usual preliminary service as Vice-President, and have therefore not had the benefit of two years' preparation which is the usual lot of Presidents. My address to you this afternoon had perforce to be hastily prepared; and I must ask your indulgence if it fails to come up to the high standard of excellence achieved by previous occupants of the presidential chair.

A great deal has been written and spoken of late regarding the position of the gas industry and its failure to meet fair competition in the field of supplying light, heat, and power. It has been stated quite recently, both by a prominent official connected with the industry and by a technical correspondent of a well-known London daily newspaper, that the whole future of the gas industry is in providing cheap gaseous fuel for heating purposes. If they will only consider that at present all artificial light is obtained from highly-heated incandescent substances, and that as a prime mover the heat-engine is paramount, there is no particular objection to the statement, as it still allows gas to be an agent to be reckoned with in all present fields of usefulness.

Another fault that is laid at the door of the gas industry is that, compared with the electrical industry, the men engaged in it are not so highly trained scientifically, and do not use such exact scientific terms to express their meaning. The stigma, under which I am afraid there is a slight substratum of truth, will no doubt soon be removed from us by the excellent work which is being carried out by the Northern Universities and by various Technical Institutions. This end will take some time to accomplish, and necessitate the expenditure of much energy, as electricity has had a long start in this respect. Its study is part of the curriculum of every science school, technical college, and university, and forms part of the courses for nearly all Science and Engineering Diplomas and Degrees; while up to the present the science of gas making and use has been absolutely neglected. In addition to this, the scientific investigations of the problems of gas making are exceedingly complex, and do not lend themselves to easy mathematical treatment. Thus their study is very largely experimental, aided in many cases by trained conjecture or lucky guess; and, on this account, exact rules are scarce, and results are to a high degree empirical and rule-of-thumb. The "fit-and-try" method—the one which has based details of engineering practice upon experience—is the only one which will finally settle the performance of a new departure in plant or process; and it is often a very expensive method, as in most of our problems small-scale experiments are a very unreliable guide so far as the economies of processes are concerned.

It has often been said—and I make no apology for reiterating it—that the future of the industry is in the hands of the present juniors; and it is to them we must look to hold it in its present high position, and even push it still higher. The seniors are of necessity largely engaged in administrative work, and have not a great amount of time to spend in investigating the many technical problems which crop up. This work is delegated (and rightly so) to the juniors, each of whom—however lowly his position, or however small his responsibility—has it in his power to further or hinder that progress which is essential to our existence. And my message to each of you to-day is to see to it that no effort is spared to thoroughly understand the work you have to perform, and to labour constantly and unremittingly to improve your own knowledge of the technical principles involved and to effect all economies and improvements possible to the processes for which you are responsible. The only alternative is distinct and disastrous retrogression.

It is in assisting towards this end that this and kindred Associations come to the aid of the juniors; and we can only justify our continued existence by the success we achieve in this direction. While feeling we have every reason to be gratified with our own record, I must confess to some doubts as to whether the best use is being made of the possibilities open to us. In aiming high, let us take care lest we miss the target. The first object of each of us should be, as I have said, to attain proficiency in the daily duties which we are called upon to perform. This seems so self-evident that it should not require mention. A desire, however, to call attention to what I fear is a growing danger is my excuse for again alluding to it. Do not let the present suffer in anticipating the future. It is, or should be, the aim of all of us to fit ourselves for higher positions than we at present occupy; but we must see to it that, in doing so, we first and foremost neglect no opportunity of gaining all the knowledge and experience we can bearing on our present duties.

I hold very strongly the opinion—not by any means hastily arrived at—that, while the benefit derived from hearing papers delivered and formally discussed is of very great value, much more information of present value is gleaned from the informal conversations to which they give rise. To assist our members to attain this end should, then, be our first aim as an Association; and I suggest that more opportunities should be provided for informal meetings, which need not be general meetings of the Association. Our membership is now upwards of 120; and these numbers would, I feel sure, guarantee that sub-sections of our members interested more particularly in (say) manufacture, distribution, technical, or commercial subjects, would meet in such numbers as to ensure instructive and interesting debate.

The business of the gas suppliers is naturally divided into two sections—the manufacturing and the distribution departments—in both of which great strides have been made in recent years. The object of a gas-works is to supply gas of fairly high constant heating value, and to supply it cheaply. The day has gone by when the selling price of gas was regulated by the fad of a board of directors or by the inefficiencies of a gas-making plant. The gas industry has been for a long time in the enjoyment of a monopoly, and still is so, so far as gas supply only is concerned. But it is coming to be more and more realized that what we are really supplying is light, heat, and power, and that in this field we are subjected to severe competition. Gas is only an agent which we use to produce certain effects to which open competition assigns a definite money value. The price of gas must be, and is, fixed ultimately by this competition; and those responsible must see to it that their manufacturing processes are kept efficient to supply gas of requisite quality below this competitively fixed price.

At the present time, all our manufacturing processes are in a more or less transitionary stage; and this, however perplexing to an engineer about to adopt a new system, is, to my mind, a healthy sign. It means that thought and energy are being expended on the processes; and ultimate good must surely follow. Still, with all the improvements that have been introduced, we are very far from a scientifically ideal process. Special conditions of local customs or demands, and distances from coalfields, coke, and residual markets, all affect the economies of a gas-making process, and may cause one type of plant to be preferred to another. One striking instance of this has recently occurred with regard to a choice of carbonizing system. Though at the present time it would be safe to say that the concensus of engineering opinion favours one or other system of vertical retorts, we find a prominent engineer, on erecting a new plant, installing horizontal retorts, and justifying his choice by reference to the special conditions of his markets; and the price at which he is supplying gas (officially tested for quality) testifies to the success of his plans.

Condensation and the possibilities of auto-carburation have recently received a good deal of attention—more on the Continent than in this country. The problem of leaving in the gas as much as possible of the hydrocarbon vapours and the extracting of as much as possible of the naphthalene, has been scientifically studied, and plant introduced for removing tar-fog as soon almost

as it is formed. Rule-of-thumb methods are, however, largely practised yet, and perhaps rightly so, as an engineer is, of course, justified in adopting the method of working which experience has taught him best answers the needs of his undertaking. But it is to be hoped that before long the working conditions in each part of the gas-way from the retorts to the condensers will be studied and better understood, and that we shall not hear from two different and equally eminent sources that the best results are obtained by removing tar as soon as it is formed, and by allowing tar to flow with the gas, when the truth is that the conditions in the two plants were not comparable.

Various mechanical improvements have been introduced into washing machinery, which all tend to economy and efficiency of plant, though at present experience as to life, &c., is limited. Perhaps the process in which the greatest revolution has taken place is that of purifying. Time was when the provision of a sufficient number of lime and oxide purifiers was all that was considered necessary. After much strenuous exertion, sulphur restrictions were removed and lime purification rendered unnecessary. Oxide purifiers alone were then adopted; and though the cost of purification was low, the manifest disadvantages of having to handle large quantities of solid materials led to improvements being desired. Probably the first was the introduction of backward rotation of purifiers, which the admission of air with the gas rendered possible, thus decreasing the amount of handling required. The introduction of hurdle grids and more active oxides made it possible to extend this system; so that it has now become possible to fully charge the oxide with, at most, two changes. The Burkheiser process aims at revivifying the oxide *in situ*, and at the same time removing all sulphur from it, thus conserving the material. But it is yet too early to give figures regarding it. Of the entirely new processes, that of Feld deserves mention, as it does away altogether with the use of solid reagents, and makes the process a continuous one.

As I said above, all our methods fall far short of ideal gas making, which would turn 100 per cent. of the combustible matter of the coal into gas without loss of heat, and return all the nitrogen in marketable form (either as ammonia or cyanogen); and there is still any amount of room for original investigation and improvement to be made. Dr. Mond was eminently successful in converting the nitrogen in the fuel used in his gas-producers into ammonia; and it seems to me that, with suitable modifications, such a process might be utilized for the purpose of manufacturing illuminating gas. From our point of view, the great objection to Mond gas is the large amount of nitrogen and carbon dioxide in it, and its consequent low heating value. By a suitable arrangement of plant, however, this might be overcome, and provision be made for conserving a large proportion of the heat generated—thus giving the plant a high heat efficiency. It seems to me strange that the variation in vapour tension of the constituents of coal gas at very low temperatures has not been made use of. By high compression and the low temperature resulting from the proper expansion of the compressed gas, it would be possible to separate as liquids or solids the various constituents and impurities of the resulting gas.

The removal of the atmospheric nitrogen by fractional vaporization before admission to the combustion zone, would enable a very large amount of steam to be admitted without unduly lowering the temperature of the fuel-bed—thus increasing the ammonia yield; and the fresh charges of coal would be carbonized by the heat from the produced gases. The removal of the nitrogen from the feed air would make the process continuous, by doing away with the necessity of blow; and by a suitable arrangement for the admission of oxygen to the lower part of the producer, and the addition of some flux, the clinker might be rendered fluid, and run off as slag. Suitable arrangements for conservation of heat and for recovering power from the expanding cooled gases after compression would result in economies which, I venture to think, would put the scheme on a commercial basis.

Regarding the uses of gas and the distribution department, great improvements are being made—chiefly with regard to the use of high-pressure gas. The cause of the great efficiency of gaseous heating is the possibility of complete combustion without a great excess of air—thus having less heat carried away by waste gases, and a high temperature produced with a very high heat efficiency. Add to this the possibilities of regeneration, and we see the reason for the great increase in the use of gas for heating. To achieve maximum results, it is essential that, before burning, the gas should be mixed with just sufficient air for complete combustion. Such a mixture is highly explosive; and in order to use it in a burner, the mixture must have a very high velocity, or the flame will shoot back. To attain this velocity necessitates the use of gas at a comparatively high pressure. Low-pressure gas does not possess sufficient energy to mix with the required volume of air and impart this velocity to the mixture—hence the marked superiority in efficiency of gas under high pressure.

I have purposely said nothing of the details of the various apparatus and processes to which I have alluded, nor of the many ways in which the use of gas is advertised and its advantages shown to possible consumers, as these could form the subjects of papers which members will, I hope, bring forward during the session.

Mr. ATLEY, the Senior Vice-President, who presided, congratulated Mr. Cawthra on the great interest of his address, which had been followed with obvious pleasure by the members. It did them good to have their attention called up and directed forward to unrealized possibilities in connection with gas, and to the need not only of keeping in touch with advances in practice and in plant, but of endeavouring in some degree—even if that were but small—to help on these advances.

Mr. J. H. HILL proposed a vote of thanks to the President, in a characteristically racy and humorous speech, in which he ran full-tilt at the vaunts and claims made on behalf of electricity, with even more than his usual vigour, on this favourite subject—much to the amusement of those who happened to know that some of the local electricity officials were present. He spoke in strong praise of the address and of Mr. Cawthra's previous papers, and said he wondered that Mr. Cawthra had been so lately discovered by them. His address would bear reading and pondering over; and it should prove effective in provoking other members to activity, and in suggesting to them topics for papers and discussions. It was a reminder that their work need never be monotonous or lacking in interest, inasmuch as there was no end to the possibilities of development, improvement, and invention. They also tendered the President their thanks for his kindly and much appreciated hospitality.

Mr. WARD briefly seconded the vote.

Mr. CAWTHRA, in reply, said he had felt relieved that he could rely on the members' kindly forbearance with the weaknesses of his effort, as they realized the exceptional difficulties under which he had prepared his address. When he chose the date, he had expected some little leisure for preparation; but, as they knew, the unexpected and special conditions of the last few weeks had made heavy demands on his time and attention.

Mr. JOHN WILKINSON, who had paid his late Assistant the compliment of coming over from Nottingham to attend the meeting, expressed his pleasure in being able to do so, and congratulated him on his timely and valuable address. He was glad to see Mr. Cawthra occupying the presidential chair; and the Gas Committee and all their employees appreciated the compliment thus paid to him. He wished to associate himself with what had been said by previous speakers on fidelity and zeal in carrying out the every-day duties of their work. He had himself started humbly; and he ascribed the attainment of his present position to his resolve constantly to devote himself to the every-day duties. The brightest hopes of the industry lay in all doing this.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

The Scottish Junior Gas Association (Western District) opened the second half of their session by holding a coffee meeting on the 13th inst. in the Refectory of the Technical College, Glasgow kindly placed at their disposal by the Governors of the College. This was the first meeting of the kind held in Scotland; and it was fairly well attended. The PRESIDENT (Mr. James M'Ghee) occupied the chair.

Mr. Archibald Wylie, of the Gas Department, Glasgow, read a short paper on the question of gas companies maintaining incandescent burners. He said he was in favour of companies undertaking this work at a small charge. The paper was discussed with great freedom; and it showed that the members generally are in favour of the maintenance of burners by gas companies, either at a small direct charge, or by adding 1d. per 1000 cubic feet to the price of the gas for this service.

Mr. Neil Lindsay (Glasgow) presented a short paper on "Stock-taking and Costing;" outlining the system in vogue in the Gas-Fitting Department of the Glasgow Corporation. The paper was discussed in a very instructive manner, and with a freedom too often absent from more formal meetings of the Association.

Mr. Alex. Paterson, of the Street Mains Department, Glasgow, opened a discussion on naphthalene troubles; the discussion eliciting many varied methods of dealing with this *bête noire* of a gas manager's existence.

Altogether the meeting was so successful that it is confidently expected to be the precursor of many similar gatherings in the West of Scotland.

We have received from the office of the "Local Government Journal," 27A, Farringdon Street, E.C., the "Local Government Annual and Official Directory" for the present year. The main portion of the book is devoted to the directory, which gives the names and addresses of the chief officials of all Corporations, London Borough Councils, County Councils, Boards of Guardians, Urban and Rural District Councils, &c., throughout the kingdom, as well as a list of the City Companies of London. A feature of the book which will be found useful is the insertion of the names of the Chairmen of Committees of the London County Council and of the Metropolitan Borough Councils. In addition to the directory, there is a large quantity of useful information relating to electric light undertakings in the boroughs of London; and the charges for gas and water are shown. The contents of the book, which is edited by Mr. S. Edgecumbe Rogers, have been corrected up to the 25th ult.; and they will be found useful by all persons connected with local government, whether as members of public bodies or contractors and manufacturers. The price of the "Annual" is 1s. 6d. net.

COLOUR DISCRIMINATION UNDER VARIOUS ARTIFICIAL LIGHTS.

One has only to consider the above title, to see the importance of it in connection with the question of the lighting of shops and other places. We know generally that different artificial lights have different effects in changing the appearance of coloured objects. Therefore any work that will be useful as a guide to the suppliers of artificial light is welcome. Some such work has been undertaken by Mr. Thomas E. Ritchie; and he put the results into the form of a paper which he read before the Illuminating Engineering Society last Tuesday. There was much in the paper which must be omitted here, descriptive of the photographic methods adopted to find the relative values of lights with various colours. The following are extracts from the communication.

There are few users of artificial light who have not from time to time experienced the difficulty arising from the unpleasant changes in the appearance of coloured objects when viewed by any of the majority of the artificial illuminants commonly in use. While it has long been recognized that colour-matching can be successfully carried out by the aid of special lamps, provided with suitable filter screens—such as, for instance, the colour-matching arc lamp—little has been known, in many cases, even by those frequently called upon to advise in such matters, as to the nature and extent of the changes in appearance brought about in objects of any given colour by any given illuminant, or as to which of the many artificial lights available would in this respect most satisfactorily comply with the particular requirements of the user.

The subject is of peculiar interest and importance, quite apart from the actual matching of colours, which is now usually carried out, at all events when required at times when daylight is not available, in a small room or compartment set apart for the purpose, and illuminated by a special colour-matching lamp provided with a filter screen of the type previously referred to, and is much more widespread in its application than might be imagined.

Suppose an artist, working under suitable daylight conditions, has in the designing of, for instance, a carpet, linoleum, or piece of the beautiful hand-printed chintz now so widely used, made use of particular shades of red, yellow, green, and blue, which have been carefully and accurately reproduced by the manufacturer in the finished article, it will be obvious that, if such is exhibited by artificial light of a decidedly yellow nature—such as is produced by ordinary gas-jets or carbon filament incandescent lamps—its appearance will be completely altered. The reds will appear to be lightened considerably and will be altered in hue, the yellows brightened and changed in tone, the greens degraded and rendered yellower, and the blues darkened considerably—the intention of the designer being, by these visual changes, entirely frustrated, and the ability of the article as a whole to successfully appeal to the purchaser being correspondingly reduced.

The same thing applies with even added force to the selection by the purchaser, possessed of an educated taste, of such general objects as dress materials, haberdashery, furnishing fabrics, wall papers and decorations, pottery, water-colour drawings and oil paintings, as well as such special objects as, for instance, coloured furs (especially in reddish brown shades), artificial flowers, coloured book-bindings, &c.

The question of the most suitable artificial light, not only for the manufacture, but also for the general illumination of displays, of such goods becomes therefore of paramount importance to their makers and vendors. It is equally important to those responsible for the lighting of exhibitions of objects of art, the participators in which naturally desire to have their exhibits presented in the manner best calculated to create exactly the effect which inspires in the beholder the subtle and elusive liking for the objects seen which experience has proved is of vital importance in effecting sales. The converse is, of course, equally true. Objects designed and manufactured by an artificial light of this character being true in their appeal only when viewed by such light, and being incorrect and out of balance in their tone values when viewed by daylight.

These considerations, coupled with the difficulty of satisfactorily demonstrating such changes in appearance as are known to be brought about, without the use of a special room capable of being darkened at will, and containing a series of chambers or compartments each suitably lighted by one of the different illuminants, have led to a further careful investigation of the subject by the author, with the object of determining whether, by the adoption of the improved methods and appliances now available, such changes could not be recorded photographically with the requisite accuracy, and subsequently reproduced.

Preliminary experiments of an extensive character, which covered, among other methods, the employment of various processes of colour photography, and the making of a considerable number of exposures, elicited the fact that for the purposes in view a monochromatic rendering would be likely to prove more accurate in the results obtained, as well as more convenient for reproduction; and this being so, the use of the Wratten panchromatic plate was finally decided upon as affording the most perfect means of securing in the desired monochromatic form a truly accurate representation of the coloured objects selected for the purpose of the tests, in their correct tone values as seen by the eye. The experiments consisted in the photographing of a number of coloured ribbons firstly by daylight, and subsequently by the light of different artificial illuminants. The ribbons were stretched side by side on a board, mounted on an easel. In the case of each illuminant the intensity of the illumination (a "Lumeter" photometer was used) actually obtained upon them was, though the variation in the individual readings was quite insignificant, taken as the mean of five measurements made with considerable care—one at the centre and the others at points 4 inches each way from each of the four corners.

The final series of photographs were taken on Sept. 8, 1911; exposures being made by the light from: (*a*) Bright diffused daylight. (*b*) Inverted arc lamp. (*c*) Enclosed arc lamp. (*d*) Metallic filament incandescent lamps. (*e*) Carbon filament incandescent lamps. (*f*) Inverted incandescent gas-burners. (*g*) Ordinary batswing gas-burners. (*h*) Yellow flame arc lamp. (*i*) White flame arc lamp. (*j*) Mercury vapour lamp.

The photographs were exhibited. Referring to the daylight photograph, the author said it was taken by bright, diffused daylight between the hours of 12 noon and 1 p.m. It was noticed how well the respective colours stand out, how marked is the differentiation between the various tone values even in the darker shades, and how distinctly the texture of the ribbons and the slight light and shade effects upon them are reproduced. The tone values shown in the photograph are considered as standard in the comparisons which follow—just as good well-diffused north light may be taken as a standard of daylight, and usually is so taken by those in the habit of using colours.

The next photograph showed a strip cut from the photograph taken by the light of the inverted arc lamp placed adjacent to a strip from that taken by daylight. The lamp was of the special "OI" pattern; was one of four burning in series on a 220-volt direct current circuit, had a watt consumption (at the lamp terminals) of 430 watts, an arc voltage of 43 volts, and was burning the special carbons sold by its makers for use in inverted lamps. The tone values representing the whole of the various colours are, it was seen, in extraordinarily close agreement with those of the daylight rendering, and as such values undoubtedly correspond to the tone values of the actual objects as seen by the normal eye, they render self-evident the extremely colour-true character of the light by which they were obtained. With the exception of a very slight brightening of the reds, and an equally slight darkening of pale mauve, which could only be detected by careful observation, not only every colour, but every shade of colour in the series, appeared to be absolutely unchanged in hue or intensity, thus quite bearing out the uniformity shown in the photograph.

The succeeding photograph taken by the light of the enclosed arc lamp again compared with the daylight rendering. The lamp was of the single enclosed long-burning type, as largely used for the interior illumination of drapery establishments, was one of a pair burning in series upon a 220-volt direct-current circuit, had a watt consumption (at the lamp terminals) of 390 watts, an arc voltage of 78 volts, and was burning pure carbons of the best quality. The tone values differ decidedly from those obtained by daylight; and the following changes in the appearance of the colours were noted: Brown, darkened; reds, lightened slightly; greens, darkened considerably; purple, blue, orange, yellow, and mauve, all darkened slightly.

Then came a photograph taken by the light of the metallic filament (tungsten) incandescent electric lamps, compared with the daylight rendering. The lamps were unobscured—*i.e.*, had bulbs of clear glass—and unshaded, were each rated at 55 watts, and were run upon a 220-volt direct-current circuit, the pressure of which was carefully watched, and remained practically constant throughout the tests and exposure. The tone values obtained differ from the daylight values to a slightly greater extent than in the case of the photograph taken by the light of the enclosed arc lamp; but whereas in the latter case the greatest differences were evident in the brown, the greens and the blue, in this instance the colours most affected were the reds, the emerald green, and the orange. The changes noted were as follows: Brown, lightened slightly, and changed to reddish tint; reds, lightened many shades; emerald green, darkened, and made yellower in tone; blue, darkened, and changed to a purplish hue; and orange, brightened many shades.

The next photograph was taken by incandescent gaslight compared with the daylight rendering. The burners were of the inverted type, and were quite unshaded. The gas supply, which was ample in capacity, was taken from the low-pressure supply mains of the South Metropolitan Gas Company. The pressure, which was not measured, was apparently fairly constant. The variation between the tone values obtained, and those of the daylight rendering, differs but little from that evident in the photograph taken by the light of the metal filament lamps; and there would appear from observations made to be no question but that, at all events when both are new, the light given by a good inverted incandescent gas-mantle is, as regards its colour-revealing properties, upon the whole quite as satisfactory—or perhaps more correctly, is not more unsatisfactory—than that of an equally good metal filament incandescent lamp, and is decidedly superior to that of the carbon filament incandescent lamps experimented with. The colour changes noted were as follows: Brown, darkened; reds, lightened many shades; mauve, darkened; emerald green, darkened and made yellower in tone; blue, darkened and changed to a more navy blue; and orange, brightened many shades.

A photograph was next shown taken by the light of the carbon filament incandescent electric lamps, compared with the daylight

Changes in the Appearance of Coloured Objects under Different Lights.

Description of Light Used.	Appearance.	Colour.					
		Brown.	Red.	Green.	Mauve.	Blue.	Orange and Yellow.
Bright diffused daylight.	Bluish white or pure white.	Normal.	Normal.	Normal.	Normal.	Normal.	Normal.
Inverted "O.I." arc lamp.	Bluish white or pure white.	Normal.	Slightly brighter than normal.	Normal.	Slightly darker than normal.	Normal.	Normal.
Enclosed arc lamp.	Bluish white.	Darkened.	Lightened several shades.	Darkened considerably.	Darkened slightly.	Darkened slightly.	Darkened slightly.
Metallic filament incandescent lamps.	Yellow white.	Lightened and changed to reddish tint.	Lightened many shades.	Darkened and changed to a yellower tint.	Changed to redder tint.	Darkened and changed to purplish colour.	Brightened and changed to a more orange shade.
Inverted incandescent gas.	Greenish yellow.	Darkened.	Lightened many shades.	Darkened and changed to a yellower tint.	Darkened and changed to a redder tint.	Darkened and changed to a more navy blue.	Brightened many shades.
Carbon filament incandescent lamps.	Orange yellow.	Reddened in tint.	Lightened many shades.	Darkened and changed to a yellower tint.	Darkened and changed to a pinker tint.	Darkened and changed to a much more purple colour.	Brightened and changed to a deep orange.
Ordinary gas light.	Yellow.	Reddened in tint.	Lightened considerably.	Changed to a yellower green.	Changed to a pink rose coloured tint.	Darkened and changed to a more navy blue.	Brightened and changed to orange.
White flame arc lamp.	Bluish white.	Slightly reddened in tint.	Lightened many shades.	Changed to a yellower tint and lightened slightly.	Changed to a bluer and darker shade.	Brightened and changed to a more intense blue.	Changed to a deeper and more orange colour.
Yellow flame arc lamp.	Deep yellow.	Darkened slightly.	Changed to a brick red.	Deadened and changed to a yellower colour.	Darkened considerably and changed to a purple.	Darkened and changed to a more navy blue.	Changed to a deeper and more orange colour.
Mercury vapour lamp.	Pale blue-green.	Changed to a greenish colour.	Changed to almost black.	Lightened considerably.	Changed to a slate-blue grey.	Deadened.	Changed to a greenish yellow.

rendering. The lamps were unobscured—*i.e.*, had bulbs of clear glass—and unshaded, were each of 32-candle power, and were run upon the 220-volt direct-current circuit previously referred to. As might be expected, the tone values obtained differ from the daylight values to a much more marked extent than in the case of the metallic filament lamps, and the light is, as is generally recognized, still less perfect, as regards its colour-revealing properties. The colour changes noted were as follows: Brown, reddened in tint; reds, lightened many shades; mauve, changed to a pinker tint; emerald green, darkened considerably, and made yellower in tint; blue, darkened, and changed to a much more purple blue; orange and yellow, brightened and changed to a deeper orange; pale mauve, darkened slightly, and changed to a pinker tint.

Following was a photograph taken by ordinary gaslight compared with that obtained by daylight. The burners employed were "Bray's" No. 6. The gas supply was that used in obtaining the photograph by inverted incandescent gas-light, and the burners were unshaded. The days of the luminous gas-flame are so nearly ended that it is hardly necessary to dwell upon the colour changes noted, which were, however, as follows: Brown, reddened; reds, lightened considerably; greens, rendered yellower in tint; mauves, changed to a more rose coloured tint; blue, darkened, and changed to a more navy blue; and orange and yellow, brightened, and changed to a deeper orange.

Passing to a photograph taken by the light of the flame arc lamp. The lamp was of the direct-current type, was one of four burning in series upon the 220-volt circuit previously referred to, had a watt consumption (at the lamp terminals) of 460 watts, an arc voltage of 46 volts, and was burning, in one case, white flame carbons, and in another case yellow flame carbons. The tone values in each case again differ distinctly, as might be expected, from those of the daylight rendering; but it is interesting to note that the results obtained with the white flame carbons are upon the whole much nearer—especially as regards the lighter shades—to those obtained by daylight than are those given by the yellow flame carbons. The colour changes noted were as follows: White flame—Brown, brightened and changed to a slightly redder hue; reds, lightened many shades; greens, rendered yellower and lightened slightly; blue, changed to a much more intense blue; orange and yellow, changed to a deeper and more orange colour; mauves, changed to a bluer and darker shade. Yellow flame—Brown, darkened slightly; reds, changed to a brick red; greens, deadened and rendered yellow; blue, darkened and changed to a more navy blue; orange and yellow, changed to a deeper orange; mauves, darkened considerably and changed to a purple tone.

It should be noted that both the electric incandescent lamps and the gas-mantles used were new; the former being put into use for the first time upon the occasion of the tests and exposure, and the latter being previously used only for the time necessary for the getting rid of the reddish tinge characteristic of certain mantles when first ignited, but which disappears after a few hours use, as there is little doubt that the colour distortions produced by their light would tend to become more pronounced with age. The results observed have, for the purpose of ready reference, been assembled in tabular form.

This table shows at a glance the direction in, and the extent to, which each of the illuminants considered meets, or fails to meet as the case may be, the practical requirements not only of artists, designers, and those engaged in the drapery, textile, printing, and furnishing trades, but also of those requiring artificial light for such diverse purposes. It also makes manifest the fact that the inability to secure a really satisfactory, steady, uniform, and sufficiently colour-true light, capable of being maintained at a constant intensity for an unlimited period, and which is in this respect a distinct advance on daylight (the extreme variability of which is well known), cannot longer be legitimately put forward as being an excuse for confining classes for the teaching of oil and water colour painting, designing, &c., to the hours of daylight, or keeping Art Galleries and Museums containing expensive collections closed after sunset. It also incidentally proves that, failing the use of a colour-true artificial light, the decoration of rooms is, as regards its effects, directly dependent upon the character of the light used for their illumination; and it emphasizes the need for that closer co-operation between the decorative craftsman and the illuminating engineer which the author has previously advocated.

Points from the Discussion.

There was not much in the discussion which succeeded that can be noticed here, interesting though the greater portion of it was. There was acknowledgment by the Chairman (Mr. F. W. Goodenough) of indebtedness to Mr. Ritchie for the obvious pains and care that had been bestowed upon the preparation of the paper. The author had expressed the hope that the communication might lead to a stimulation of effort on the part of the suppliers of illuminants. There was no question that the paper would tend in this direction, because it was a wholesale condemnation of many forms of light in regard to their colour-matching capacity. At the same time, Mr. Ritchie had pointed out that, with the arc lamp, a filter could be used which rendered the light practically equivalent to daylight for colour discrimination pur-

poses. There did not appear to him (the Chairman) any reason why filters should not be designed to enable other forms of illuminants to give an equally truthful colour discrimination. The author had spoken of the light of the ordinary batswing burner; but he (the Chairman) was glad to find he went on to say that it was a form of gaslight that was practically extinct. One might, in fact, describe it as extraordinary rather than ordinary. He should have been pleased if Mr. Ritchie had included in his experiments high-pressure gaslight, because the character of the light from a mantle used with high-pressure gas was certainly somewhat different from that given by a mantle employed with low-pressure gas. As a rule, there was greater whiteness in the light. He should be interested to see some experiments carried out in this direction.

There were several speakers in the discussion; but the practical side, from the point of view of the providers of illuminants, was altogether overshadowed by (though interesting) views on scientific light phenomena. Mr. M. Laudon, of the Westminster Art School, and Mr. Thornton, who is interested in the lighting of pictures, contributed to the discussion. The latter did not see why any gas or electric light could not be used for lighting pictures, provided their rays were properly screened. Mr. Mackinney and Dr. Kenneth Mees followed; the latter pointing out that it was very difficult to interpret the results shown in the paper without knowing the spectral distribution of the light sources employed, which would complicate the matter very considerably. But he thought the results served their object most admirably as being a practical guide. For this purpose they seemed to be excellently adapted, and should be of use for the people for whom they were meant. Then Mr. A. P. Trotter spoke, and expressed the opinion that while the paper purported to deal with colour discrimination, it really dealt with colour photography. Another difficulty from the point of view of criticism was that those present had not seen the colours which Mr. Ritchie had used, but which he had attempted to describe in terms of the well-known Lovibond tintometer. The description was a purely arbitrary one. However, they had observed from the paper that the inverted electric arc with the filter was the best light, and that the others were practically useless, for the purpose of photography in tone colours. Mr. Trotter then proceeded to describe some work upon which he is engaged, dealing with colour discrimination by the eye. Following came Mr. Lovibond, who, in the course of a learned disquisition, remarked that the difficulty of measuring colours by artificial light was so extreme that unless one had a standard to refer to—and he was personally convinced diffused daylight was the best—one could not arrive at quantitative results; and before much real work could be done, there must be a quantitative statement of colours. The mere eye could not realize it, because every sensation to get a reliable impression must be accompanied by the conditions under which that sensation was created.

Dr. Green seemed doubtful as to Mr. Ritchie's results. He had shown the differences of colour obtained in daylight and with artificial illuminants. But they must not forget how extremely variable was daylight. Then Mr. Justus Eck exhibited a picture half of which had been painted in daylight, and half using an inverted arc lamp. To the eye in the electrically lighted hall there was no appreciable difference between one part and the other. Mr. Eck also mentioned that the artist found he could get the same illumination conditions for his work at any time with the electric arc; and this uniformity he could not get with daylight. Mr. Haydn Harrison hoped that Mr. Ritchie would not find a lamp that would always give absolute daylight. He thought they would always have to have a certain lack of colour discrimination by artificial light. Artificial light was part of our everyday life; and colours chosen with an artificial light made to approximate daylight might be very disappointing indeed when they came under the artificial lights of daily life. He could not see, under the circumstances, that colour discrimination by artificial light was going to be very useful, in view of the fact that—say, in the case of a lady's evening dress—the colour would not be worn under the light by which discrimination of the colour was made. Dr. Mees showed the difference between the colouring of Mr. Eck's picture under a metallic filament lamp with a filter that made the light the equivalent of daylight, and under the same type lamp without the filter. In the case of the artificial daylight, the colouring looked faded as compared with the light from a naked metallic filament lamp. Mr. Gaster also contributed to the discussion; and Mr. Ritchie's reply ended an interesting and instructive meeting.

The Vertical Gas-Retort Syndicate, Limited, inform us that the Dessau Company report that the following further orders have just been received for Dessau verticals. For the Mersburg Gas-Works (Germany), three beds of ten 4-metre retorts—making 30 retorts in all; and for the Seville Gas Company (Spain), ten beds of fifteen 4-metre retorts—making 150 retorts in all.

The Directors of the Tottenham and Edmonton Gaslight and Coke Company, after placing £2000 to the renewal fund and £1000 to the insurance fund, recommend the payment for the past half year of the full statutory dividends of 7⅛ per cent. per annum on the "A" stock and 5⅝ per cent. per annum on the "B" stock—carrying forward £33,141. A year ago, the dividends were at the rate of 7 and 5 per cent. respectively; and the carry-forward was £23,736.

ELECTROLYSIS IN UNDERGROUND PIPES.

INSULATION AS A MINIMIZING FACTOR.

By E. B. Rosa and Burton M'Collum.

[Paper prepared for the Sixth Meeting of the American Gas Institute.]

Introduction.

The protection of gas and water pipes and other buried structures from damage by electric currents has long been one of the most important, and at the same time one of the most difficult, problems with which the engineer has to contend. There are few problems that affect a greater diversity of interests, or involve the welfare of greater amounts of property, than those arising from the presence of stray currents in the earth. The phenomenon of the electrolysis of gas and water pipes by stray currents from electric railways has been the subject of a vast amount of study and experiment; and much information has been brought to light, and a great deal of progress made, in methods of minimizing the trouble from this source. There remain, however, many problems on which further light must be thrown before remedial measures can be applied with that degree of certainty which modern engineering practice demands.

Closely related to electrolysis from stray currents, and inseparable from it in any comprehensive investigation of the subject, are the phenomena of self-corrosion or auto-electrolysis, due to the presence of cinders, particles of coke, and other substances which give a difference of potential against iron, or are due to the physical condition of the pipe itself. The corrosion due to this cause is fundamentally a phenomenon of electrolysis, and the resulting damage is often difficult, if not impossible, to distinguish from that due to stray currents from electric railways. During recent years, also, attention has been drawn to the possibility of the destruction of reinforced concrete structures by stray currents, and considerable apprehension has been aroused lest reinforced concrete buildings, bridges, &c., might be damaged or destroyed by electrolysis. Whether grave danger of this kind actually exists in practice, the possibility of such danger having been established, the problem becomes one of extreme importance, since not only are vast property interests concerned, but there exists also a possibility of serious hazard to human life. Further, any measures that may be taken to protect gas or water pipes from electrolysis will at the same time affect, in a greater or less degree, the possibility of danger to reinforced concrete structures, since the pipes usually enter such buildings, and afford one of the principal means of entrance of stray currents into the reinforcement of the concrete. It is evident, therefore, that any comprehensive investigation into the subject of electrolysis must be considerably broader in its scope than those investigations usually undertaken with a view to protecting pipes alone.

Recognizing the importance of the subject, and acting in response to requests from important engineering interests, the Bureau of Standards has undertaken an investigation with a view to throwing as much light as possible on the different phases of the problem and their relation to each other. The work was begun July, 1910, and has since been carried on by laboratory investigations, by correspondence with engineers and corporations, and by investigations in the field under practical conditions. During the autumn and winter of 1910, the work was confined largely to a study of the effects of electric currents on concrete, and of auto-electrolysis; but in the early part of 1911, the work was extended to include laboratory and field work covering the general subject of electrolysis—special attention being given to methods of minimizing it. It is not to be expected that an investigation of this character and magnitude can be brought to a conclusion in a single season; and up to the present time [October, 1911] only certain phases of the problem have been investigated fully enough to justify even a progress report being made on them at this time. Much important work in connection with various methods of minimizing electrolysis remains yet to be done; and it is planned that this work shall continue as long as circumstances may require.

The Scope of the Investigation.

In taking up this problem, it is not the intention of the Bureau to make investigations under local or exceptional conditions, with the view merely of remedying the evil in particular cases, nor to invade the field now occupied by the consulting engineer, but rather to confine ourselves to the broader and more general aspects of the problem, and to render as much aid as possible in bringing to light information and in establishing general principles of service to the engineer in dealing with the infinite varieties of situations that present themselves in practice.

Of the dozen or more methods that have been proposed or tried for minimizing electrolysis, there is none which will not, when properly carried out, result in greater or less reduction in the damage due to stray currents. On the other hand, there are few, if any, of these methods which will not, when wrongly applied, yield unsatisfactory results, either through failure to accomplish the results desired or by imposing unnecessary hardship on the parties interested. Vast sums have been spent in unsuccessful and ill-advised attempts to remedy the evil; and these errors could have been avoided if the persons in charge of the work had had a thorough knowledge of the difficulties confronting them. It is of first importance, therefore, in dealing with any situation where

serious damage may occur, to place the work of mitigation in charge of a competent engineer. The farther our knowledge of the matter advances, the more important this becomes, since only the specialist can be expected to acquire that broad knowledge of the subject and the maturity of judgment that are essential in securing the maximum of protection at a minimum cost.

The Proposed Remedies.

In discussing the various remedies that have been proposed for reducing the damage to pipes due to stray currents, the methods may be broadly grouped under four heads: (1) Those which have for their object the keeping of the currents off the pipes altogether, or reducing them to a negligible quantity; (2) those which, while they do not tend to reduce the currents in the pipes, but rather to increase them, are designed to permit the currents to flow off in such a way that they can do little or no injury; (3) those which contemplate the use of alternating currents or periodically reversed currents in connection with railway systems; and (4) the use of chemicals, such as lime around the pipes, to prevent electrolytic action.

The first of these methods may again be subdivided into four groups: (1) Those which aim to eliminate earth currents entirely, as the double-trolley system and its equivalents; (2) those which aim to reduce the difference of potential between different portions of the system to so low a value that they will do no appreciable harm, as by the use of negative return feeders to rails, careful bonding, boosters, &c.; (3) those which, while they make no attempt to reduce potential differences in the earth, due to the railway currents, aim to locate the pipes where the potential gradients are too low to cause appreciable currents to flow in them; and (4) those which aim to protect the pipes by some method of insulation, or partial insulation, whereby the currents on the pipes are reduced to a negligible minimum.

While investigations have been in progress for some time tending to throw light on all of these various methods (and they will be treated in later reports), only the last one—viz., the method of insulation—will be dealt with in the present paper. In thus confining ourselves to the discussion of one general method of minimizing electrolysis, it is not to be understood that we regard this as necessarily the best method of preventing the trouble, but rather because our investigations relating to other methods have not yet been carried far enough to justify us in attempting to summarize the results. Our investigations relating to the method of insulation will be pushed further; and other and more complete papers will be published as the work proceeds.

Experiments to Prevent Electrolysis.

When troubles from electrolysis first began to assume serious proportions, following the general introduction of trolley systems in cities, one of the first remedies to suggest itself was that of insulating the pipes. Numerous attempts were made at different places to protect pipes in this way; but in most cases the results were uncertain or unsatisfactory. Attempts were made to protect them by laying them in conduit, and in other cases by embedding them in cement; but neither of these methods proved of material value. The reason for their failure is simply that such materials absorb moisture, and, when wet, have considerable electrical conductivity, so that current can enter and leave a conduit-enclosed or cement-coated pipe almost as freely as one laid in earth. A company are now manufacturing a cement-coated cement-lined pipe which it is claimed has in a number of cases been subjected to severe conditions for years without any trouble from electrolysis; and this freedom from trouble has been attributed to the cement coating. In these cases, however, the pipes were laid with cement joints also; and there is every reason for believing that these have been responsible for the protection afforded the pipes. The company who manufacture these pipes have, however, had considerable trouble with the cement joints, due to mechanical imperfections, and have recently adopted the use of lead joints in connection with the cement-coated pipes, and are installing them on the assumption that these will be as free from electrolysis as the older line with cement joints.

In order to test the relative value of the two kinds of pipe-lines, and to determine, if possible, whether cement-coated pipes with lead joints would be more affected by electrolysis than the same pipes laid with cement joints, the Bureau of Standards has laid in Washington two parallel lines of such pipes, 100 feet long and 20 feet apart, one using cement joints throughout and the other using lead joints throughout, and has kept them subjected for some months past to identical conditions as regards danger from electrolysis. The arrangement of the pipes is shown in fig. 1. Near each line at either end, and about 2 feet from the pipes, was buried a single length of ordinary cast-iron soil-pipe; and these were connected together in pairs as shown, and used as terminals on which a difference of potential of about 15 volts was constantly maintained. At the middle of each line, an insulating plate was inserted to separate the two halves electrically, and two insulated leads were brought up from the ends adjacent to the place in which an ammeter could be inserted for the purpose of measuring the current flow in the pipes. The readings obtained from time to time are shown in Table I. It will be noted that the current in the line having lead joints is several hundred times greater than that in the cement-jointed line. On Oct. 13, 1911, a portion of the pipes was uncovered near the positive end and examined; and it was found that, while the pipes provided with cement joints were still in practically as good a state of preservation as when first laid, the line having lead joints showed marked evidence of corrosion; the outer metal sheath protecting the cement coating of the pipe proper having been eaten entirely through in several places. These results indicate very clearly that the immunity from electrolysis which these pipes have possessed in the past is due mainly to the fact that they were laid with cement joints, and that the same pipes laid with lead joints, as is now being done, are by no means free from trouble; the cement coating in itself not being effective in keeping the current off the pipe. This is further substantiated by experiments recently carried out at the Bureau of Standards on the subject of the electrolysis of iron embedded in cement and concrete.

Table I.—*Currents Flowing in Parallel Lines of Cement-Covered Pipe, with Lead and Cement Joints.*

1911.	Current in Lead-Jointed Line L^1.	Current in Cement-Jointed Line C^1.	Ratio $\frac{L^1}{C^1}$.
June 19	0·275	0·0012	229
,, 23	0·278	0·0011	252
,, 30	0·265	0·0009	294
July 7	0·290	0·0010	290
,, 14	0·245	0·0008	306
,, 21	0·265	0·0014	186
,, 28	0·268	0·0009	297
Aug. 11	0·275	0·0007	393

Table II. gives specific resistance measurements on a number of samples of earth taken from around pipes in different cities, and also similar measurements on specimens of wet portland cement. The figures show that, while there is considerable variation in the specific resistance in both the earth and concrete, the average resistance of the cement and concrete is lower than that of the earth tested. Further, it has been shown by several investigators that iron embedded in cement or concrete not only corrodes quite readily when an electric current flows from the iron to the cement, but that the cement itself is soon destroyed by the mechanical pressure developed around the iron.

Table II.—*Relative Specific Resistance of Representative Specimens of Earth and Wet Concrete.*

Per Cent. Moisture in Soil.	Specific Resistance of Soil.	Character of Soil.	Character of Concrete.	Specific Resistance of Concrete after Soaking in Water 24 Hours.
10·23	8,709	Sandy	—	—
12·28	2,914	,,	—	—
13·23	1,335	,,	—	—
20·48	2,300	Clay and vegetable matter	—	—
21·88	1,074	Earth and cinders	Neat cement	6100
26·53	14,025	Blue clay	1 : 2 mortar	3200
5·97	44,440	Yellow clay and gravel	1 : 2½ : 4 concrete	4900
16·72	1,797	Clay and gravel	1 : 3 : 5 do.	4700
19·29	3,783	Blue clay	—	—
Aver. for soil	8,930	—	—	4725

Some Preventive Measures Tried.

Painting of pipes or otherwise insulating the surface by the use of treated papers and textiles was early resorted to as a possible

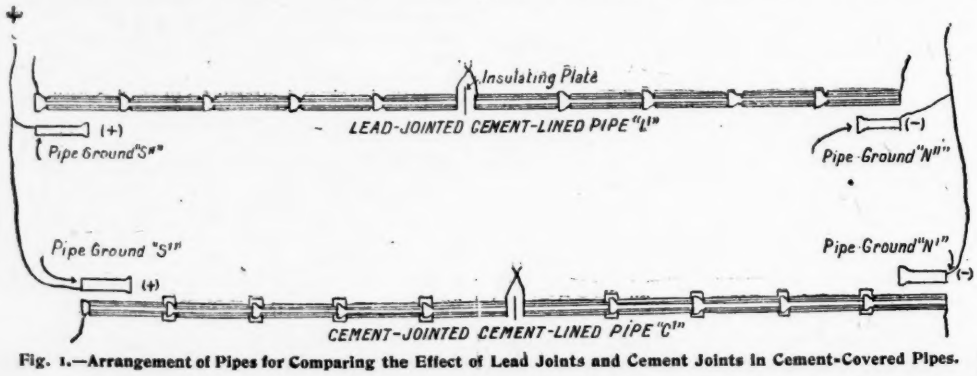


Fig. 1.—Arrangement of Pipes for Comparing the Effect of Lead Joints and Cement Joints in Cement-Covered Pipes.

method of protecting pipes from electrolysis; and this method is still in use in some instances. It is doubtful, however, whether there exists any case in which it has been definitely proved that insulating paints have effectually protected pipes from electrolysis; while there are many instances where they have failed utterly, and where their presence has probably done actual harm. This statement may seem rather surprising to some who are familiar with instances where paints have withstood the action of soils for a long period of years, and, when uncovered, both paint and pipes appeared to be in about as good a condition as when they were laid years before. Practically all such paints are commonly classed as insulators; and it is quite natural, therefore, that the impression should be gained by many that these paints ought to prove equally as effective as a protection against corrosion in the soil. In practice, however, such paints behave at best in a very uncertain manner. A given paint may endure for long periods in some places; while in other sections of the same city the paint may deteriorate rapidly and become worthless in a comparatively short time. This is due partly, no doubt, to differences in soil conditions; but the general failure of these paints under conditions where electrolysis was to be expected indicates that stray currents themselves may have something to do with the destruction of the coatings. With a view to throwing light on this point and also to determine, if possible, something of the relative value of different paints and coatings as a possible protection against electrolysis, the Bureau of Standards has undertaken a series of experiments which, although still incomplete, have yielded a considerable amount of definite information. [Details of the tests are given in the paper.]

Out of the sixteen different kinds of paints and pipe-dips thus far treated, using forty specimens, only one seems to be holding out for any considerable length of time, even under the mild conditions of the test. The first failure occurs in a single spot, raising a blister, and in the case of anode rapidly eating a pit in the metal. If the specimen is left in circuit, with constant voltage applied, the coating ultimately breaks down in other spots, and the pitting extends over the entire surface. The vital weakness of all the paints thus far treated is due to the simple fact that none of them are entirely non-absorbent. If a paint could be secured that was absolutely impervious to soil moisture, and which would remain so for an indefinite period, it would prove an effective preventive of electrolysis; and all efforts to produce such a protective paint should be directed to the one point of making it permanently and absolutely moist-proof.

Many manufacturers of paints now on the market claim that their product is entirely moisture-proof; and they will often present elaborate experimental data in support of their contention. In practically all cases, however, these tests, while sufficient to show that the paints possess considerable power to resist moisture, are not sufficiently delicate to determine whether or not they are capable of meeting the severe conditions required in protecting pipes from electrolysis. The manner in which the paints usually fail under electric stress shows that they might, under certain circumstances, increase the trouble from electrolytic action. Breaking down, as they do, at isolated points, the discharge of current from the pipes is concentrated at these points, and the pitting is likely to be more serious than if the paint were not used at all. In all areas, therefore, where the pipes are strongly positive to earth, these paints are likely to do more harm than good; and it would be better to omit them altogether. In places where the pipes are practically neutral, or negative to earth, they can do no harm, even if they do fail in spots; and in such places they may be of value in reducing the flow of current in the pipes, and in preventing soil corrosion.

Another method of insulating pipes that has frequently been used is by the application of treated papers or textiles to the surface of the pipes. A complete series of tests of such materials is planned, and some of the tests are now under way; but in most cases they have not proceeded far enough to yield positive results, though it may be said that in most cases the results to date are very much more promising than those obtained with paints and dips. This is doubtless due mainly to the fact that a better and more uniform coating can be obtained with these materials.

Some experiments which we have had in progress for some time in connection with the waterproofing of concrete are of interest here. Concrete specimens, waterproofed with three and five layers of felt treated with asphalt and interspersed with layers of asphalt compounds, after standing in water for four months show no sign of electrical conductivity through the coating, and the absorption of water has been extremely slow. With two layers of the felt and compound, slight conductivity has developed in two specimens out of a total of eight. These coatings have been subjected to an electrical stress of 15 volts continuously. The average absorption for the specimens waterproofed with three layers of the felt compounds has been 53 grammes per square foot of surface. Of this, 41 grammes were taken up during the first two months of the test and 12 during the last two. These tests show that they slowly absorb moisture; so it seems altogether probable their failure is only a question of time. The thicker such coatings are made, the longer will be the time required for trouble to develop; and in certain cases, where the cost is not prohibitive, it may be possible to protect the pipes for a considerable time by the application of a sufficiently heavy coating. This has been accomplished in some cases where the pipes have been laid in a trough, and this filled with pitch. If a good grade of pitch and a sufficiently thick wall be used, the pipe may be protected for several years; but the protection should at best be regarded as a temporary one until further and more favourable experimental data are obtained.

These tests are to be continued until all available paints, dips, and wrappings that are recommended for the protection of pipes have been thoroughly tested.

Insulating or Resistance Joints.

Another method of reducing current flow in pipes (one which has found extensive application within the last few years) is that of breaking-up the continuity of pipe-lines by the use of insulating or resistance joints. In ordinary wrought-iron or steel mains, with screwed or riveted joints, the resistance of the joints is usually small in comparison with that of the pipes; and when these pipes are laid in localities where there is an appreciable potential gradient in the direction of the pipe, currents of considerable magnitude will usually be carried by the pipes. In the case of cast-iron mains using lead joints, the resistance of the joint is often as great as, or greater than, that of a section of pipe; and it is not uncommon to find a lead joint having resistance equal to that of several hundred feet of pipe. It is due largely to this fact, and to the higher electrical resistance of cast iron, that such pipes carry considerably less current under similar conditions than wrought-iron or steel pipe. The frequent injury to cast-iron pipes by electrolysis has shown, however, that the resistance of lead joints is far too small to reduce the current to a safe value, even under ordinarily severe conditions. Attempts were therefore made to still further reduce the current in the pipes by the introduction of specially designed joints of high resistance.

Following the earlier attempts to prevent electrolysis by this method, very strong claims were made for it by its advocates; some of them claiming that they had completely solved the problem by the use of insulating joints. Within a few years, however, a noticeable reaction set in. Many engineers criticized the method; and some of those who were its warmest advocates in the beginning abandoned it. It is but natural, however, that the initial attempts to apply this method should have resulted in some disappointments; and it is not safe to consider these early failures too seriously in judging the value of the method when properly applied. At that time no experience had been gained in regard to the frequency with which such joints should be used, the proper location of the joints, the kinds of joints best suited to certain conditions, and the complications arising from the presence of other pipe systems not so insulated. All these are important factors, and must be carefully considered if the maximum of protection is to be secured at a minimum cost. Despite the criticism it has received in some quarters, the method has steadily gained in favour, and is more frequently encountered at the present time than ever before.

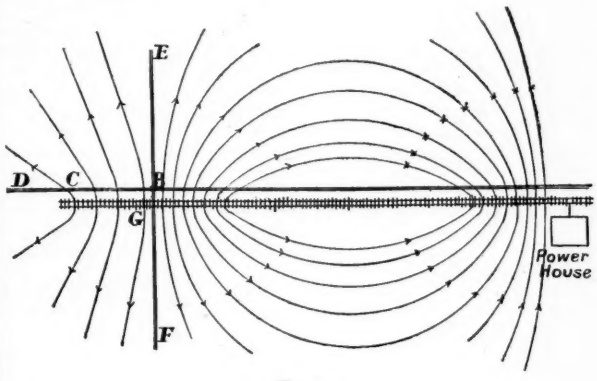


Fig. 2.

A number of cases have come to our attention where systems in which insulating joints have been installed have nevertheless suffered severely from electrolysis. In every case that we have examined, however, there has been good reason for believing that the trouble was due either to the use of an insufficient number of joints, or to the fact that they were not located in such places as to be most effective in reducing danger. A very common procedure has been to place, in a pipe-line running at right angles to the track, a single insulating joint on either side of the track, and a few feet therefrom, and to assume that this insulating joint should prevent current from getting from the tracks into the pipes beyond the joint. The reason why this might fail to protect the pipes in many instances can be seen by reference to fig. 2, in which the dotted lines and arrows indicate the general direction of the flow of current in the earth in the case of a simple straight-line railway free from any complicating circumstances, such as pipe systems, adjoining railways, &c., and in which the load is assumed to be well out towards the farther end of the line. It will be seen that at points near the power-house, current tends to flow into the tracks from the surrounding earth; and at the farther end of the line it tends to flow radially outwards in all directions—the flow of current at the extreme end of the line being in a direction away from the power-house.

If we measure potential gradients in the region indicated by B, E, F, C, D, we find that very considerable potential differences exist between different points of the earth, as between G and E,

or between C and D. As a rule, when track conditions are good, these potential differences will be high only when near the track—becoming small at distances of 50 or 100 feet or more from it. Under some circumstances, however (as with heavy loads, or with a bad condition of the track between A and B), potential gradients of considerable magnitude may exist between points located at some distance from the track—as, for example, between B and E. An insulating joint placed at B will, of course, reduce greatly the current that will flow in the pipe from A to E; and if the potential gradients are small enough, the single joint at B may be sufficient to reduce the current to a value that will do no harm. If, however, owing to any of a number of conditions that may arise in practice, the potential gradients in the earth should not be low, there may be sufficient difference of potential between the points B and E to cause considerable current to be picked up by that portion of the pipe, and thus give rise to electrolysis in the region beyond the joint B. Similarly, between C and D we may have, at points entirely beyond the terminus of the railway system, the condition of currents flowing in the pipes away from the power-house, even though an insulating joint may be placed at C; and if conditions at points beyond D should be such as to cause this current to be discharged locally, serious electrolysis might occur at points remote from, and entirely beyond the range of, the system. The mere fact, however, that insulating joints at the points B and C will not entirely prevent such conditions from arising, is no valid evidence that such joints are of no value, though they have often been condemned because electrolysis has occurred under conditions exactly similar to those outlined above. It simply means that, after the joints at B and C were installed, there still remained extensive areas where pipes were laid in soils in which there were considerable potential gradients parallel to the pipes. There being no insulating joints in those areas, currents must inevitably flow in the pipes. If a suitable number of insulating joints had been properly distributed between B and E and between C and D, these currents could have been kept down to any desired value, and the trouble avoided.

In determining, by actual experiment under practical conditions, just how effective insulating joints may be in reducing currents in pipes, it would be very desirable to select a particular insulation, and then make a complete survey of the system, including current measurements in the pipes, and instal, at points indicated by the survey, a complete system of insulating joints. After this, the current measurements in the pipes could be repeated, and thus unquestionable data be obtained as to the effect of insulating joints on the flow of current. We have not as yet been able to make a test of this sort; but it is hoped that in the near future arrangements can be completed for carrying out an investigation of this kind under actual conditions. We have, however, in connection with other lines of field work, made excavations and measured the flow of current in pipe-lines provided with insulating joints at more or less frequent intervals, and by comparing these with similar measurements on lines not provided with insulating joints, but otherwise similarly situated, a good idea may be gained as to the extent to which the currents are reduced by the joints.

In making such measurements, the method used was the one most commonly employed by engineers for this purpose—viz., to expose a portion of the pipes between adjacent joints and with a milli-voltmeter measure the drop of potential between two points a measured distance apart. The size, type, and class of pipe being known, and the specific resistance being obtained from tables prepared for this purpose, the current in the pipe could be calculated with a sufficient degree of accuracy for work of this kind. If it were desired to repeat readings after the excavations were filled, permanent contacts were made by sawing in the pipe a slot about 1-16th inch deep, and riveting the end of a No. 16 rubber-covered wire into the slot—the other end being brought to the surface for connection to the milli-voltmeter when desired. The junction between the copper and iron should be carefully covered with paraffin, pitch, or other insulating material, to protect the junction from corrosion.

Wherever practicable, the current measurements were made in cities where one pipe system only (either water or gas) was provided with insulating joints; and by selecting places where the pipes of the two systems lay parallel and near together for some distance, it was possible to obtain points at which the two systems were subjected to similar conditions, except for the insulating joints. In this way a fairly definite idea as to the effect of insulating joints could be obtained. Such readings are, of course, not altogether satisfactory; for there was often a difference in the material of the pipe, and in some cases a difference in size; and allowance should be made for these. There was also the uncertainty in regard to the ramifications of the network to which the lines were connected. But, in general, the conditions were sufficiently similar to indicate clearly the effect of the joints.

A number of these current readings in parallel mains are shown in Table III. In test No. 1, made in Wilkinsburg, the measurements were taken on the 8-inch water-main, provided with an insulated leadite joint; and on the same street measurements were taken on a 6-inch gas-main provided with lead joints throughout. As shown in the table, the current in the former was 0·6 ampere and in the latter 1·37 amperes—indicating appreciable reduction, though the difference is small. It is important to note, however, that in this case the leadite joints were at a considerable distance apart, averaging several thousand feet; and, further, they were not installed with the idea of making them insulating, so that in many cases the joints were of low resistance, owing to contact between the bell and the spigot ends of the pipes. In test No. 2, measurements were taken on a 12-inch main provided with a leadite joint every 12 feet, and on a parallel 16-inch main with lead joints throughout. The difference here is very marked; the current in the lead-jointed line being more than 80 times that in the line having leadite in every joint. Similarly in test No. 3, where also one line was provided with a leadite joint every 12 feet, the difference is even more marked; the current in the case of lead joints being about 120 times that in the pipes having leadite joints. In test No. 4, the difference is much less—partly due, no doubt, to the difference in size of the pipes as shown by the table. The chief factor, however, is the distance between the leadite joints; this being in the present instance about 300 feet. Tests Nos. 5 to 11 inclusive were made in Erie (Pa.), on wrought-iron gas-mains, provided with Dresser couplings at irregular intervals, and on parallel cast-iron water-mains with lead joints.

In comparing these figures, it should be borne in mind that cast iron has a much higher resistance than wrought iron; and, further, that the lead joints themselves introduce considerable resistance into the circuit, so that the real effect of the Dresser joints is much greater than the figures would indicate. While considerable variation exists in the ratios of current in parallel mains in the different tests of this series, they show, without exception, very great reduction in current due to the insulating

TABLE III.—*Flow of Currents in Parallel Mains.*

[Tests Nos. 1 to 4 refer to Wilkinsburg; Nos. 5 to 11, to Erie; and Nos. 12 to 14, to Ashtabula.]

No. of Test.	Mains.			Type of Joint.	Distribution of Insulating Joints in Mains	Section in which Drop was Measured.		Average Potential Across Section.	Ampéres in Pipe.
	Type.	Class.	Size.			Distance to Joint.	Length.		
			Inches.				Feet.	Millivolts.	
1	Cast	D	8	Leadite	Insulat.	Adjoining	9	0·20	0 60
	,,	A	6	Lead	None	,,	6	0 40	1·37
2	,,	A	12	Leadite	12 feet	,,	11½	0·013	0·65
	,,	C	16	Lead	None	,,	6	0·20	5·55
3	,,	D	12	Leadite	12 feet	,,	10⅛	0·013	0·72
	,,	C	16	Lead	None	,,	8	0·83	8·66
4	,,	D	12	Leadite	300 feet	,,	11	0·02	0·106
	,,	C	4	Lead	None	,,	6	0·30	0·695
5	Wrot.	Stand.	6	No. 6 D	Insulat.	,,	3	0·005	0·167
	Cast	C	6	Lead	None	,,	3½	0·80	4·60
6	Wrot.	Stand.	4	No. 6 D	Irreg.	,,	3½	0·01	0·26
	Cast	C	4	Lead	None	,,	10¾	8·00	12·80
7	Wrot.	Stand.	6	No. 6 D	Irreg.	,,	3	0·0025	0 086
	Cast	C	20	Lead	None	,,	10½	1·90	22·60
8	Wrot.	Stand.	4	No. 6 D	Irreg.	,,	2½	0·01	0·236
	Cast	C	4	Lead	None	,,	7	0 15	0·30
9	Wrot.	Stand.	6	No. 6 D	Irreg.	,,	1½	<0·0025	<0·196
	Cast	C	6	Lead	None	,,	11½	0·02	0·75
10	Wrot.	Stand.	8	No. 6 D	Irreg.	,,	2½	<0·0025	<0·156
	Cast	C	6	Lead	None	,,	11¾	2·40	4·46
11	Wrot.	Stand.	3	No. 39 D	20 feet	,,	22	0·005	0·108
	Cast	C	6	Lead	None	,,	10½	2·00	3 90
12	Wrot.	Stand.	3	No. 6 D	Irreg.	1000 feet	10	1·20	<0·0125
	Cast	C	10	Lead	None	,,	10	0·30	1·29
13	Wrot.	Stand.	3	No. 6 D	Irreg.	1300 feet	4	−0·01	−0·104
	Cast	C	12	Lead	None	,,	10	0·50	2·91
	,,	C	12	Lead	None	,,	10	0·20	1·16
14	Wrot.	Stand.	3	No. 6 D	Irreg.	500 feet	10	0·015	0·62
	Cast	C	10	Lead	None	,,	10	5·00	21·50

joints. Taking the average of the six tests of this series, we find that the current in the lines having lead joints averaged about 58 times that in the lines having insulating joints. In all these cases, except in test No. 11, the insulating joints were irregularly spaced; the distance between the joints in various parts of the system varying from 300 to several thousand feet. This fact being considered, the relatively low values of current in the lines provided with insulating joints is quite remarkable. In the last three tests (Nos. 12, 13, and 14), the ratios of current in the lead-jointed lines to that in the lines with insulating joints is respectively 103, 28, and 346. But in these tests considerable allowance must be made for the relatively large size of the cast-iron mains, as shown by the table. A remarkable feature of test No. 13 was that the direction of flow of current in the gas-line having insulating joints was opposite to that in the lead-joint line. This is due, no doubt, to the fact that the gas-main was discharging current into the water network occupying the same district, as an insulated one may give rise to abnormal local conditions which may tend to cause trouble to the insulated line.

(To be continued.)

THE MEASUREMENT OF ILLUMINATION.

At the Regent Street Polytechnic last Thursday, Mr. J. S. Dow delivered the second lecture of the second half of the course on the above subject.

The lecturer opened his discourse by explaining that the previous week (see p. 152) he had dealt with the measurement of the actual light of sources—the candle-power, as it was termed in this country; and he now proposed to discuss the nature and value of measurements of illumination. After a brief explanation of this term, he pointed out that there were practically only two units—the "foot-candle" and the "lux"—now in use; the latter mainly on the Continent. The value attached to the lux (or candle-metre), however, depended on whether the international or the Hefner unit of light was employed; the relation between the units being, very approximately:

1 Foot-candle = 11 Lux (International)
= 12 Lux (Hefner).

Mr. Dow next proceeded to trace the gradual development of different branches of photometric measurement. Originally we were contented with measuring the illuminating power of gas or oil; but afterwards more attention was paid to the candle power of the actual sources, whether using incandescent mantles, flames, or electric glow-lamps, &c. Still later, Sir William Preece laid stress on the importance to the consumer of measurements of the actual illumination enjoyed in the street or on the table. It should be carefully noted that he did not suggest that illumination measurements should take the place of determinations of candle power—it was an additional process. In the same way there might be room for quite a variety of instruments—some in the nature of travelling photometer rooms equipped with complete facilities for exact testing in specification work; others of a simpler and more portable character intended for purely commercial work and for demonstration purposes. If one desired to make illumination measurements a simple familiar thing to engineers as a whole, portability and simplicity were essential. In addition, such an instrument should possess, if possible, an accuracy of the order of 5 to 10 per cent., should be capable of being pointed in any direction, should be simple to work and explain, and should be readily rechecked and set right if it went out of order.

Dealing with the design of illumination photometers, Mr. Dow made passing reference to instruments based on the extinction of visibility and on acuteness of vision. He exhibited the Simplex photometer as an example of this type. Though enviably simple, such instruments were not precise enough for many practical purposes; and, therefore, some form of instrument having within it a temporary standard was needed. Of recent years, fairly general agreement seemed to have been reached that, in spite of the inconvenience of an accumulator, which required periodical recharging, an electric glow-lamp formed the best standard for such instruments. The lecturer then proceeded to show a series of slides illustrating the original Preece and Trotter, Sharp and Millar, Everett-Edgcumbe, Harrison, and Martens photometers—the three last-named being subsequently exhibited and explained to the audience. The "Luxometer" instrument, derived from the older Everett-Edgcumbe illumination photometer, was also shown, and finally the "Holophane" lumeter. Especial stress was laid on the convenience of detaching and separating one of the photometric surfaces, so that it could be viewed from a distance and measurements readily carried out in vertical, horizontal, and distant places.

As an illustration of the uses of illumination photometers, Mr. Dow presented a series of data obtained in various schools, railways, &c., explaining that he would return to these in a later lecture. It was also pointed out that instruments of this type were very convenient in enabling surface brightness to be measured; and the meaning and method of expression of this term were explained. For example, the lecturer had recently made a number of tests in various rooms, and had come to the conclusion that, in a cheerfully lighted interior, the surface brightness of the walls should not be less than 0·3 foot-candle. A comparison of the local illumination and the surface brightness also enabled one to determine the reflecting power of wall-papers, newspapers, &c.; and a number of samples of such materials were shown, and some figures for their reflecting power quoted. Mention was also made of the distinction between the reflection from a shiny and matt surface respectively, as illustrated by the silvered screens sometimes used in cinematograph work.

Another interesting application of surface brightness measurements was as a means of determining the necessary exposure in taking photographs of artificially lighted interiors; and an album containing a large number of photographs of this description, taken respectively by Mr. V. H. Mackinney and Mr. T. E. Ritchie, was exhibited. Good photographs of this kind, the lecturer pointed out, required special skill, and were very valuable to companies interested in lighting problems.

The next matter touched upon was the question of the best methods of taking illumination measurements in streets and open spaces. Most authorities seemed now to be agreed that if illumination was to be measured, the determination should take place in a horizontal plane. For instance, the German Institution of Electrical Engineers had recently agreed that such measurements, whether made in a room or out of doors, should be taken in a horizontal plane one metre from the ground.

Some account of the *pros* and *cons* of illumination and candle-power measurements for street lighting specifications was next given. A Committee were, he said, sitting to discuss this matter. But whatever decision they arrived at one could be certain that some form of specification of the light supplied would be expected in the future.

The lecturer then passed on to measurements of daylight, pointing out the peculiar difficulties introduced by its variations, and by the wide range demanded of an instrument intended for this purpose. He briefly referred to some of the usual rules adopted by architects for window space in rooms, and described the Thorner illumination tester. The difficulty was to dissociate the variations in climatic conditions from the qualities of the room examined. Most methods depended on establishing a ratio between the brightness of the sky or the unrestricted illumination out of doors with the illumination prevailing in a room. The latter method had been adopted by Mr. P. J. Waldram; and apparatus for this purpose had been fitted to the Everett-Edgcumbe and "Holophane" lumeter instruments.

In conclusion, the lecturer insisted on the value of measurements of illumination as a means of establishing a record and of backing an opinion by definite figures in order to prove whether a given room was sufficiently lighted or the reverse. The next lecture would deal with shades and reflectors. When discussing this subject, he would make use of photometric methods. They would also find that much that had been said about the treatment and behaviour of the eye in Dr. Ettles's lecture had a very direct bearing on successful illumination.

ARCHITECTS AND ILLUMINATION.

Remarks on Mr. Darch's Paper.

The reading, by Mr. John Darch, F.S.I., of the paper on "Illumination as a Study for Architects," at the Society of Architects some extracts from which were given in the "JOURNAL" last week (p. 152), was followed by a discussion.

Referring to the remarks by the author on the subject of the lighting of libraries, Mr. Freyberg said he thought it would be impracticable to have a light for each reader in a free library—leaving the user to switch it off when he had finished with it. Mr. Tucker pointed out that architects were limited by their clients to a certain expenditure; and this limit left very little for use in connection with any special scheme of lighting. They could not afford to provide the amount of light necessary for lighting a room by reflection from the ceiling, owing to the great quantity lost. Mr. V. H. Mackinney expressed the opinion that architects should place confidence in the illuminating engineer, even if they were experts in one particular direction. There was a difference between the actual effect of daylight and illumination by artificial light. In daylight, the surroundings were very bright, and exercised a controlling influence on the aperture of the pupil of the eye; whereas to artificially illuminate a room with many foot-candles would mean the use of a concentrated light producing very dark surroundings. Mr. J. S. Dow said he felt there must be many instances where an architect required a certain arrangement of lights on account of the architectural features of a building, and such arrangement would be governed by quite different factors from those usually employed by the illuminating engineer.

In replying to the remarks, Mr. Darch said the architect was the man who held the key to the situation. If he would turn his attention seriously to the question of lighting, he could do more for them than any other person. Mr. Freyberg had suggested that readers could not be trusted to switch off the lights; but he (Mr. Darch) thought they could. Mr. Tucker said that indirect lighting could not be adopted in many cases owing to its cost; but he (the speaker) was of opinion that, light for light, and effect for effect, it could be installed at an equal cost with direct lighting. It was not the fact that light lost by reflection within a room. He had said very definitely that daylight should be the guide to artificial lighting.

SULPHUR COMPOUNDS IN BENZOL.

At a recent meeting of the Newcastle Section of the Society of Chemical Industry, Mr. J. G. ELLERTON read a paper on "The Estimation and Elimination of Sulphur Compounds in Commercial Benzol." The following extracts are taken from the text of the communication as given in the current number of the Society's "Journal."

Though many compounds of sulphur occur in benzol, the principal are carbon bisulphide, thiophen, and mercaptans. Of these three forms, the first and second predominate, and the third may be neglected.

Carbon bisulphide seems to have been noticed in benzol in the first instance by Vincent and Delachanal. It is met with mostly in the commercial 90 per cent. benzol; but even in the "pure benzene" (so-called), Liebermann and Seyewetz found from 0·2 to 0·3 per cent. of this body. The peculiarly offensive smell of impure carbon bisulphide is quite indistinguishable when that substance is present in benzol even to the extent of as much as 20 per cent.

Thiophen was discovered in commercial benzol by Victor Meyer. It is the cause of some colour reactions formerly ascribed to benzol itself by Baeyer, Classen, and Laubenheimer. Thiophen and its homologues are a source of trouble in the manufacture of products from benzol. They cause in nitrobenzol and in nitrotoluol a yellow colour which develops by contact with air, and shows in aniline and toluidine made from them. Hence the importance to aniline-colour makers of procuring a benzol reasonably free from thiophen. Couple with this the fact that benzol is used to some extent as a motor spirit, and for the enrichment of gas, and the necessity that its sulphur content should be a minimum can be appreciated.

A series of experiments has been made, with the object of finding the best commercial method of removing these sulphur compounds, and at the same time of testing the accuracy of the several existing methods for their estimation. The results obtained in regard to the latter will be described first.

The Carius method of determining sulphur in organic compounds is not applicable in the case of benzol, owing to its low content of sulphur. Two methods were tried. The first is the "two-crucible method" of Garrett and Lomax, which was proposed by its authors for the determination of sulphur in petroleum. From the excellent results it gave in that particular case, it was hoped that it would prove equally applicable to benzol. However, the results obtained, though of value, were generally low. For example, one result showed 750 grains of sulphur per gallon; whereas the correct figure was 864 grains. The low results may be accounted for by the readiness with which the benzol vaporizes, and thus to a large extent passes from the sphere of action before the lime becomes sufficiently hot to bring about the complete decomposition of the sulphur compounds.

The second method is Irwin's, which is that generally accepted for sulphur in benzol, and is an adaptation of the familiar Gas Referees' test. It consists in burning the benzol, diluted with methylated spirit, in an ordinary spirit-lamp the top of which is surrounded by ammonium carbonate. Ammonium sulphate and sulphite are formed as a result of the combustion and subsequent combination of the oxides of sulphur with ammonia, and are retained in the condensed liquor, which is washed out and filtered. The filtrate is oxidized with bromine water, and the sulphur is estimated in the usual manner as barium sulphate. Repeated experiments with this method gave results considerably below the true value as determined separately from the percentage of carbon bisulphide and thiophen. Here it should be added, in justice to the originator, that he points out this fact in his original communication. It is noteworthy, however, that the results obtained agree closely with one another, and it was found from experiments conducted with known quantities of freshly distilled carbon bisulphide dissolved in spirit that the correct value might be deduced by multiplying by a factor approximating to 1·8. The following table shows some of the results, in grains per gallon, obtained.

	(1)	(2)	(3)	(4)
Sulphur present .	486	486	486	564
,, found .	277	283	270	307
Factor	1·75	1·72	1·80	1·83

Passing from the estimation of total sulphur to that of carbon bisulphide alone, the method of Nickels was finally adopted for the latter. It consists in agitating with alcoholic potash the benzol to be examined, and converting the potassium xanthate so formed into cuprous xanthate. When experiments were being made, it was found that much time could be saved by titrating the acetic acid solution of potassium xanthate with a deci-normal solution of copper sulphate, using potassium ferrocyanide as an indicator. This modification, devised by Macagno, is more rapid and more accurate than the gravimetric method. An approximate value may be obtained from the specific gravity by subtracting from it the value 0·885 and dividing by 0·00346. For example, benzol which has a specific gravity ·900 would contain 4·3 per cent. of carbon bisulphide. Advantage was taken of this rough method to estimate the percentage of carbon bisulphide during various stages of a distillation of crude benzol. The results for a still containing 1200 gallons are as in the following table.

Gallons Distilled.	Specific Gravity at End of Fraction.	Carbon Bisulphide. Per Cent.	Gallons Distilled.	Specific Gravity at End of Fraction.	Carbon Bisulphide. Per Cent.
60 ..	0·914 ..	7·54	160 ..	0·889 ..	1·70
80 ..	0·904 ..	3·00	250 ..	0·888 ..	0·76
100 ..	0·898 ..	3·40	270 ..	0·887 ..	0·63
120 ..	0·898 ..	3·40	350 ..	0·884 ..	0·12
140 ..	0·895 ..	2·60			

Thiophen is estimated by a method due to Denigès. A concentrated solution of mercuric sulphate is added to the benzol dissolved in methyl alcohol, and the precipitate so formed is dried at 115° C. and weighed.

It seemed probable that the low values in Irwin's test for total sulphur, previously referred to, might be due to the presence of carbon bisulphide masking the thiophen reaction. However, the discrepancy could not be explained on this assumption, for though it was found that carbon bisulphide did to a slight extent interfere with the reaction between the thiophen and the mercury salt, it was noticed that a gelatinous precipitate—presumably a molecular compound of mercuric sulphate and carbon bisulphide—was formed. A sample of the first runnings from a benzol distillation contained 1·3 per cent. of thiophen. On removing the carbon bisulphide by means of alcoholic potash, the percentage was 1·35—practically the same. But as 12 per cent. by volume of bisulphide had been removed, the thiophen should have increased to 1·48 per cent., which proves that the first result was false, and that the determination had been affected by the presence of the bisulphide. As the amount of carbon bisulphide in ordinary 90 per cent. benzol is less than 1 per cent., this will not alter the value of the Denigès test.

The next point is the practical means of eliminating these sulphur compounds. Carbon bisulphide, in virtue of its different boiling-point, is easily removed by fractional distillation. The removal of thiophen, however, is a matter of greater difficulty, because it has a boiling-point near to that of benzol. The general method for its removal is by treatment with strong sulphuric acid; but the proportion removed depends entirely on the strength of the acid, and, in general, only the strongest acid has any appreciable action. The next table contains some of the results obtained with different percentages and strengths of acids.

Acid Strength.	Quantity Used.	Thiophen Before. Per Cent.	Thiophen After. Per Cent.
169° Twaddel. . .	8 per cent. in three washes	1·22	0·23
169° ,, . . .	8 ,, ,, in eight ,,	1·22	0·59
169° ,, . . .	8 ,, ,, in one wash	1·22	0·47
Fuming acid, sp. gr. 1·87 . . .	6 ,, ,, in three washes	1·22	0·22
Fuming acid, sp. gr. 1·87 . . .	5 ,, ,, in one wash	1·22	0·27

This acid treatment for the removal of thiophen involves a loss of crude benzol which may vary between 8 and 12 per cent., and in cases exceeds the latter figure.

With a view to finding, if possible, a method for eliminating thiophen, which would not involve any considerable loss of benzol, some experiments were made with such oxidizing agents as ozone, hydrogen peroxide, and lead oxide. A sample of benzol was subjected to the action of ozone. As results, there was a slight black deposit due to oxidation of impurities; the loss was small—well under 3 per cent.; the odour of the benzol was much improved; the effect on the fractionation was very small indeed; while the duration of the treatment was from 15 to 20 minutes, and no long period of settling was necessary.

The acid washing involves a loss of three times that of the ozone process. The time required for its completion is several hours; while the cost of treatment amounts to about £2 per 1000 gallons, against 10s. per 1000 gallons in the case of ozone treatment. But the ozone treatment fails to remove the thiophen sufficiently to admit of it ever becoming a serious rival of the old acid process. To give an example, a crude benzol contained 0·88 per cent. of thiophen. After treatment with ozone it contained 0·80 per cent., as compared with 0·45 per cent. after washing with concentrated sulphuric acid. Further experiments with ozone and small quantities of lead oxide, and also with hydrogen peroxide, likewise gave very unsatisfactory results. With hydrogen peroxide the loss in volume of the benzol was only 1 per cent., while the thiophen content was practically unaltered.

Ozone has a slight action—too slight, however, to be of any practical value; and hydrogen peroxide none at all. All this goes to prove that in the purification of crude benzol of its thiophen and complex tarry bodies, oxidizing agents play a subsidiary part, and that the real process of refining is one of polymerization and condensation.

In conclusion, it might be of interest to give the total sulphur, in grains per gallon, in some typical 90 per cent. benzols: Benzol from Durham tar, 250; Yorkshire tar, 240; Lancashire tar, 49; Staffordshire tar, 504. Crude coke-oven benzol, 64·4.

British Commercial Gas Association.—A meeting of members representing subscribing undertakings in the Southern district was held last Wednesday at Caxton Hall, Westminster, under the auspices of the Southern District Association of Gas Engineers and Managers, when candidates to represent the Southern District on the General Committee of the British Commercial Gas Association were duly nominated.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

The Lighting at the Water-Cress and Flower Girls' Mission.

SIR,—My attention has been drawn to a discussion in your columns regarding the comparative cost of electric and gas lighting, in which reference is made to some figures compiled by me as the result of a test for the very purpose of this discussion.

I notice that these figures are criticized as being those of a new gas installation in comparison with an old electric installation, to which I would reply that, if a perfectly up-to-date (duplicate mains, fuses, &c.) installation becomes out of date or old in nine years, then what can be said of the economy of its installation at all.

I have this morning, for the express purpose of sending the results to you, made an accurate test of consumption, in the presence of my assistant, for a period of thirty minutes, as a test I made on the 10th (to which I will refer later) was not quite close enough for my purpose. Here are the figures for this morning's test:

High-Pressure Gas Lighting.

(Installation made January, 1910, as a result of previous experience in the use of both electricity and gas.)

		Cubic Feet.
Jan. 15, 1912—		
Index of lighting meter . . .	7.45 a.m. ..	032620
,, ,, ,, . . .	8.15 ,, ..	032740
Consumption		120

The following lamps were burning:

Candle power . . .	60 ..	100 ..	150 ..	300
Number	10 ..	3 ..	4 ..	34

In all, 51 lamps, with total illuminating power of 11,700 candles.

This candle power costs, upon a basis of 2s. 8d. per 1000 cubic feet of gas, about 7·68d. per hour.

Now as to the cost of compressing. We had originally an electrically-driven compressor which consumed ¾ unit on an average per hour. But the *power was so unreliable*, through being cut off at odd times, and the cost of energy—5½d. per unit was charged as lighting current—so high that we exchanged for gas-engine drive; and the consumption of gas is now about 19 cubic feet per hour for power for compressing.

Further comment from a consumer's standpoint is needless.

HORACE W. THOMPSON.

The Crippleage, Sekforde Street, E.C., Jan. 15, 1912.

[PREVIOUS TEST.]

The test referred to above by Mr. Thompson as having been made on the 10th inst. (and which was not quite satisfactory through gas being in use at the time for purposes other than lighting) is described in a previous letter, which reads:

I took a test this afternoon of our gas consumption, but found that it was unreliable, as we also had on twelve presses, two gas-rings, two gas-steam radiators, and four goffering stoves, with the following lamps all burning:

Candle power . . .	60 ..	100 ..	150 ..	300
Number	11 ..	4 ..	6 ..	35
	660 ..	400 ..	900 ..	10500

Total illuminating power, 12,460 candles.

The total consumption of gas for thirty minutes was exactly 200 cubic feet for these various purposes, equalling 400 cubic feet per hour at a cost of 1s. 0½d. *per hour*. *Electric light alone* would have cost upon *new* lamps of similar capacity, at the highest possible efficiency, 13·7 units at 4½d. per unit (the rate at which we are now supplied) 5s. 1½d. per hour. But, of course, upon the Electric Company's statement, we are now over-lighted to the amount of 75 per cent. But that is *only their opinion*.

Cannock Gas Purchase Question.

SIR,—In your issue of the 2nd inst., on page 38, you refer to the controversy with regard to the purchase of the gas-works at Cannock; and seeing that you have made one or two references to this matter, I have been looking for further notice of the later developments.

I enclose you herewith a copy of the "Cannock Advertiser" in which a letter from me appears, dealing with some of the points Mr. Hunt raised in his letter of Dec. 23 last; and I also send you a "Cannock Advertiser" for Jan. 13, stating what the statutory meeting thought of the purchase proposals.* In his letter to the paper which probably prompted your note, Mr. Hunt dragged in Nuneaton leakage, and stated it as 16·69 per cent., whereas it is 13·58 per cent. In the same letter, he gave our make per ton as 11,540 cubic feet, whereas in the latest return it is given as being 11,840 cubic feet. He said nothing about gas being distributed at Nuneaton at high pressure. I have pointed out one of these errors to Mr. Hunt; but he has not seen well to correct it. Mr. Hunt further referred to a recent arbitration case where the leakage was not 16 per cent., but 26 per cent., and in which eight gas experts were engaged, when the necessity of re-piping the district was never suggested, and the claim made on behalf of the purchase authorities for an allowance for putting the mains in order was successfully resisted. This is of more than passing interest.

If, Sir, this is the argument that is put forward by experts in these cases, what are we to expect laymen to understand? It is tantamount to saying that the mains in any particular district are just as valuable for purchase purposes whether there be a leakage of 25 per cent. or 50 per cent. Is this the sort of statement that Mr. Hunt wishes to rely on? Does such an argument reflect on the industry? What does it mean? It means that, though a gas undertaking is working under an Act of Parliament, that the Act is so loose that the gas authority can pay their dividends at the expense of the consumer—that, in effect, it would pay the gas authority to have a big leakage account, because, though the consumer has to pay for the leakage, whatever it may be, the value of the undertaking having a big leakage is not prejudiced. It matters not to me if there are twenty experts engaged in such arguments. They are irrational to a degree, by whomsoever they may be held.

Now, with regard to the purchase of the Cannock gas undertaking. You have referred to my having said that the works should be scrapped. I did say so, and that is my opinion—including the retorts; for in these days in what better way can we consider the consumer than by first of all seeing that our works are equipped in an up-to-date manner, capable of turning out gas at the lowest cost price, so that he (the consumer) may not be taxed on account of obsolete and old-fashioned plant.

These matters of purchase are discussed just as if the consumer were the "milch cow," and all that can be taken from him should be taken. This is not my idea of the best interests of the industry being served. The purchase question is often faced from the one aspect: What is the profit being made out of the consumer? And on this is based the purchase price.

To me, the first question is: What is the lowest price, under the best conditions, at which gas can be sold to the consumer? Then, What is the profit that we are entitled to make on this cost price? In other words, the consumer should be given something like consideration. I do not mean to infer necessarily that the consumers at Cannock at the present time are charged more for gas than they should be; but I do say that they will be charged more for the gas than they should be for the next twelve years or so, if the Council purchase it at anything like the price named. And for this reason: At present, the capital is round about £40,000. The price the Council have to pay is round about £90,000. How can such a purchase be in the interests of the consumer, all other things being equal?

It is all very well for Mr. Hunt and others to point to gas undertakings conducted by various councils which are making big profit, and which are taking good, round sums for the relief of the rates. What has enabled them to do this? Generally speaking, it is due solely to the high prices charged to the consumer in the earlier days. It is tantamount to arguing that a gas-works with no capital at all has been infinitely better managed than the gas-works whose capital is fairly represented by its works. In the former case, the shareholders in the past have been done out of their rights, and the profits to which they were entitled have gone to wipe off capital. In the latter case, the shareholders have been receiving profits as they have been made.

Again, how better can gas consumers be served than by a private company governed by Act of Parliament, in which the consumers, as ratepayers, have a voice? Already there are men in Cannock talking of money being paid over for the relief of rates if the purchase be carried out. What does this mean but that the consumer is to help to pay other people's rates?

I know there are two sides to all questions as a rule; and when one argument is met by another, and one statement of fact by another statement of fact, the discussion of a subject may be interesting. But when personal equations are brought in, the whole question becomes of indifference or of insignificant interest to general readers.

I hope that in the future, no matter how many cases of transfer Mr. Hunt may have been engaged on, he will remember it is not the number of cases or the high office he may hold that has anything to do with an argument, but the facts, sound reasoning, and ability which he can bring to bear on the subject concerned. I have yet to learn that it is the etiquette of Westminster to value evidence by the man rather than by the fact; to drag in figures that have nothing to do with the argument; or to fail to acknowledge errors in such figures when they are pointed out.

GEO. HELPS.

Nuneaton, Jan. 20, 1912.

* The matters referred to here will be found noticed in our news columns. —ED. J.G.L.

An Electric Wire and a Fire at Winchester.—On the night of Thursday week, there was an outbreak of fire at the millinery shop of the Misses Wayland, in Southgate Street, Winchester. Examination by experts, after the fire was extinguished, led to the conclusion that it originated through the fusing of an electric wire near the shop window. The Water and Gas Company did their duty most amiably, notwithstanding the cause of the outbreak, by providing a plentiful supply of water.

A Blackpool Experience.—In reference to the recent article on "Rational Gas Cooking" in our pages, in which there was allusion to Marks's gas-oven heat distributors and meat-roasters, mention was made of the number adopted in Blackpool. Mr. H. Denton, the agent at this popular seaside resort, writes to say that he has been going through the list of his local orders for the heat-distributors, and finds they rather exceed the 5000 mark. He adds that all residents in Blackpool who let apartments to visitors or have boarding-houses have gas-ovens, with which they cannot dispense; and they have purchased from him a heat distributor. "I can assure you," he remarks, "that they are wonderfully liked—in fact, I have been frequently told by users that they get such results as they never before could obtain from their gas-stoves."

Birmingham Water-Works.—At a meeting of the Association of Birmingham Students of the Institution of Civil Engineers last Thursday, at the University, Mr. F. W. Macaulay, the Resident Engineer at the water-works of the Corporation in Wales, read a paper entitled "An Outline of the Birmingham Elan Supply Water-Works." He gave an interesting description of the methods and principles of design and construction of the works in the Elan Valley, and spoke of the area and character of the gathering-ground and of the rainfall upon it. He explained the construction of the impounding reservoirs, the method of working the filters, the treatment of the water, the building of the aqueduct, and many other matters. He then described the Frankley works, and gave much information concerning the service reservoirs, the pure-water reservoir, and the pumping-station.

MISCELLANEOUS NEWS.

GAS COMPANIES AS CHEMICAL MANUFACTURERS.

Suggested Restriction of Powers.

At a Meeting of the Chemical Section of the London Chamber of Commerce held last Tuesday—Mr. JOHN C. UMNEY in the chair—the powers sought by the South Suburban and Wandsworth and Putney Gas Companies, in their Bills before Parliament next session, with respect to the manufacture of chemicals, were under consideration.

The SECRETARY (Mr. C. E. Musgrave) read a letter he had received from Mr. William Pearce, M.P. (Limehouse), calling attention to the particular powers sought by the above-named Companies, and stating that they were considered to be "highly dangerous to the position of the chemical trade," and should be brought under the notice of the Section.

The CHAIRMAN said copies of the Bills referred to were before the meeting. The matter involved was rather technical, and he did not know whether the powers sought by the two Companies were greater than those at present possessed by gas companies, so far as the manufacture of chemicals was concerned. If they were, they, as a Section of the Chamber, would protest.

Mr. PEARCE stated that he and others had been brought into contact with gas companies for a number of years; and their experience was that there was a disposition on the part of many of them to press their case before Parliament to the detriment of the private manufacturer. This fact led people to watch very carefully the powers the companies sought in their Bills. During the coming session, many Gas Bills would engage attention. Two or three of them proposed very large amalgamations; and the proposals embodied in the measures were of a character which he felt fully justified him in directing attention to one point which had an important bearing upon the chemistry industry. Without referring to the Bill of any company in particular, he had to emphasize the fact that if many of the measures were passed in their present form, the companies promoting them would be given absolute and unlimited powers to engage in competition with chemical manufacturers. These powers would not, in any respect, be on a level with those already granted to gas companies under existing Acts. As a matter of fact, they would exceed them in at least one important respect.

A MEMBER asked if the powers alluded to would be in advance of those conferred upon the Gaslight and Coke Company.

Mr. PEARCE said he thought they would. As he read the clauses of the Bills mentioned, they not only allowed the two Companies to work up bye-products, but to extend their operations by the purchase of other materials for manufacturing purposes without any restriction whatever. This really was the point he wished to bring before the Section. It was not his desire to suggest any action that should be taken in the matter; but he certainly thought—and there were members who would agree with him—that the Bills propose to give the Companies powers to manufacture chemical products beyond those which they actually possessed. If he was right in this, the matter was one which called for the serious consideration of the Section. Gas companies were in a privileged position, and even now had advantages which rendered it almost impossible for the ordinary manufacturer of chemicals to compete with them in the generally understood meaning of the term. The Section would be entirely mistaken if they accepted the assurance of the Companies that they did not intend to exercise all the powers which their Bills, if passed, would confer upon them. If the members of the Section, as manufacturers, allowed the Companies to get a position from Parliament on certain defined principles, the measures they obtained would enable them to put in force all the powers which the position would confer. Personally, he thought the Section would be justified in entering a formal protest to the granting to gas companies of powers which were other than reasonable—powers such as the clauses he referred to proposed to give them.

Mr. BULWER HOWELL, dealing with the subject from a legal standpoint, said that the powers sought in the two Bills named distinctly went beyond those at present enjoyed by any gas company. The existing powers, so far as he was able to read them, were confined to the actual dealing in the residuals which the Companies themselves manufactured. But the new powers proposed would enable them to carry on any business incidental to gas manufacture; thus enabling them to manufacture other articles in competition with people engaged in the chemical trade, and to do so on terms which were unequal. The only way to effect the defeat of a proposal of this kind was to lodge petitions against the Bills. Protests were of no avail. If petitions were presented, the Parliamentary Committees before whom the Bills came would attentively consider them.

Mr. T. TYRER asked what would be involved if the Chamber presented a petition?

The SECRETARY replied that if the Chamber endorsed the request for a petition from a Section or a number of members of the Chamber, the Council paid the costs up to the presentation of the petition—up to £16 or £17. Any costs incurred after that were either defrayed by the members concerned or a guarantee fund was raised.

Mr. PEARCE expressed the opinion that the presentation of a petition was not a serious matter; and it might lead to negotiations. He did not desire to clip the wings of the Companies, but simply to keep their powers within reasonable limits. If a petition brought them into contact with the two Companies concerned, and led them to remove from their Bills the features now objected to, it would be a valuable instrument.

The CHAIRMAN moved: "That this Section endorses the objections raised against the proposed clauses of the Bills before Parliament giving power to certain gas companies to manufacture chemical products beyond those which they have hitherto possessed, and will be prepared to support such objections by a petition to Parliament or otherwise; and that the Council of the Chamber be requested to lodge a petition accordingly, for the purpose of securing *locus standi* before the Parliamentary Committee to which the Bills are referred."

Mr. TYRER, in seconding the motion, said that in looking at clause 5 of one of the Bills he found the words "as defined by this Act, and may produce, purchase, store, sell, dispose of, and deal in" such articles as those made by the ordinary chemical manufacturer. Such a power would, he said, destroy the very elements of legitimate competition.

The SECRETARY remarked that by securing *locus standi* before the Parliamentary Committee an opportunity would be afforded for negotiation. If the Companies saw that the Section was in earnest, they might come to terms.

The motion was carried unanimously.

Mr. PEARCE pointed out that, in passing the resolution, the Section was not opposing the Bill of any particular company but taking objection to a common principle which was antagonistic to the interests of firms engaged in chemical manufacture.

HAMPSTEAD PUBLIC LIGHTING SCANDAL.

Mr. Arthur Trewby's Views.

Correspondence on the above-named subject is being continued in the local papers; and the following letter from Mr. Arthur Trewby, addressed to the Editor of the "Hampstead and Highgate Express," appeared in that paper last Saturday.

Sir,—In looking through the accounts of the meetings when the question of conversion came before the Borough Council, one point stands out clearly, and that is that the so-called Business Sub-Committee were determined from the outset to replace gas with electricity. As recorded in your columns, the two offers of the Gaslight and Coke Company were met by reduced estimates from the Lighting Committee. The Gas Company guaranteed an average of 60-candle power in their lamps; the Committee guaranteed nothing. If the Committee's estimate in the first place was correct, how was it possible for them to reduce it? The Gas Company no doubt were willing to do the work on the smallest margin of profit possible. So much the better for the Hampstead ratepayers. But the Borough Council have no right to run any risk in the matter. If the light from the gas-lamps fell below the guaranteed power, the Company could be compelled to keep it up; but who is to keep the Borough Council's light up to its nominal candle power?

That the change did not meet with approval at the time is shown by the letters in your paper in the autumn of 1910. In one of them it is noted that "the lights are now so feeble that it has been found desirable to remove the glass from the lanterns, so that the slight absorption of the light by the glass should not further reduce the illumination." This is no doubt the explanation of the facts recorded in your last issue by Mr. Keith [see *ante*, p. 96], who complained about the distortion of the lamps owing to the glass being removed. He also gave figures to show how much lower the candle power is now, as compared with that on which the estimates were framed.

In December, 1909, the Gas Company offered to erect experimental lamps; and this offer was accepted by the Council in January. But, owing to an oversight of one of the clerks of this "Business" Committee, the acceptance of the offer was not communicated to the Gas Company. Experimental lamps were, therefore, not put up till June. But in the meantime the Committee had proceeded with their pet project; and 340 lamps had then been converted, and sanction for 700 more obtained. The Committee, not an independent body of ratepayers, thereupon reported, without making any scientific tests of the light given, that "they were satisfied that, for the purposes of street lighting, they [the experimental lamps] were no better than the present upright burners; and that the illumination was certainly not so good as that provided by the electric lamps." Could anyone have expected them to report otherwise? Be it noted, in passing, that, with the time of the Committee's visit known, it was quite easy to make the electric lighting considerably better than usual. A new estimate was, therefore, concocted, making out a reduction on the Gas Company's tender—this in face of the well-known fact of gas having superseded electricity in some of the most important parts of London, and that the recent tenders for the lighting of Westminster revealed a difference of from 30 to 80 per cent. in favour of gas, light for light The tenders for electric light were, however, from commercial companies, and not from a Borough Council, which makes all the difference.

I understand that the Committee have claimed that it should always have the last word in tendering—that is to say, that they should be at liberty always to undercut those tendering in opposition to them. I wish I were allowed to say more on this question. Enough evidence, however, has, I think, been brought forward to show where the real blame lies. As an engineer, I have every sympathy with those gentlemen who are now made the scapegoats. But, before they are dismissed in this ignominious way, I think an inquiry should be held into the whole affair.

I see that the Gas Company "asserted that if the Council proceeded with the electric lighting scheme, instead of accepting their offer, there would be a direct loss to the ratepayers of £13,800 in eight years, and a probable indirect loss of £16,000 in that period. They also asserted that it would result in a far less efficient lighting of the streets." The Company's statement about the probable indirect loss was characterized by Alderman Pritchard as "moonshine." I wonder what he thinks of it now, and of the direct loss of over £10,000 in two years.

It has been said that local government is still on its trial, and if in a borough such as Hampstead, with its large leisured class available for service on the Council, such a scandal as this can take place, how can we wonder at graver ones in less favoured parts?

The Perfecta Company, Limited, has been registered with a capital of £30,000, in 29,000 ordinary shares of £1, and 20,000 preferred shares of 1s., to undertake the construction of gas-generators.

HIGH-PRESSURE GAS LIGHTING IN GLASGOW.

Important Installation Projected.

The Committees on Gas Supply and on Watching and Lighting of the Glasgow Corporation have lately had under consideration the report of a deputation which, in accordance with remits by the Corporation in August and September last, visited various cities in England and on the Continent, with the object of investigating the system of street lighting by high-pressure gas. The deputation consisted of Bailies Paxton and Kirkland, Convener and Sub-Convener of the Gas Committee, Mr. J. W. Pratt, the Convener of the Sub-Committee on Lighting, and Messrs. James Stewart (Broomielaw), James Stewart (Townhead), the Gas Engineer and Manager (Mr. Alex. Wilson, M.Inst.C.E.), the Inspector of Lighting (Mr. S. B. Langlands), and the Town Clerk. They visited Manchester, Birmingham, and London; and then the same party, with the exception of the Messrs. Stewart, visited Berlin. The following is their report:

The deputation were greatly impressed by the installations of lighting seen by them in the various cities visited, and, after serious consideration, beg to recommend, in the installation of high-pressure gas lighting already agreed upon to be proceeded with around St. Andrew's Halls, the Mitchell Library, and adjacent streets, as follows:—

1.—That the compressor should be situated between the St. Andrew's Halls and the Mitchell Library, in a temporary building erected for the purpose, and should be gas-driven, having a capacity equal to 5000 cubic feet. This compressor will require to be duplicated.

2.—That lamps of 4300 and of 2800 candle power be erected around the St. Andrew's Halls and the Mitchell Library; that two lamps of 2800-candle power each be erected in Granville Street; and that three lamps of 2800-candle power each be erected in North Street—all these lamps to be placed on pillars on the edge of the pavement. That Bath Street and the connecting streets to Sauchiehall Street be lit with lamps of 2800-candle power—twelve lamps to be placed in Bath Street from North Street, and suspended above the centre of the street, to enable a test to be carried out as to the lighting powers of lamps so hung as compared with the remaining lamps, which will be placed diagonally throughout the streets.

3.—That all lamps be so arranged that only one burner shall be used after midnight.

4.—That, in view of the numerous types of good lamps on the market, offers be taken for a supply from each of the makers, to enable an exhaustive test to be made as to the relative lighting efficiency thereof. In the meantime, it is intended to erect an approved type of lamp in the streets surrounding the St. Andrew's Halls, the Mitchell Library, and the other streets adjacent thereto.

5.—That the pillars be of one make and type, but that the method of suspension of the lanterns from these pillars be varied; some being placed in harp-shaped pendants and others suspended from the various types of swan-neck brackets, so that the effect of vibration on the lanterns and mantles may be noted.

[A sketch of the plan of the streets and the points where the deputation suggested that the lamps should be erected was submitted with the report.]

There can be little doubt that the system of street lighting by high-pressure gas is a great advance on the existing system of incandescent gas; and the members of the deputation were struck by the fact that in the cities which were visited the tendency is to extend the same throughout their areas. To enable a comprehensive test of this method of lighting being carried out, the deputation would suggest that it be remitted to the Sub-Committee on Lighting to prepare and submit a scheme of lighting an additional number of streets in the city.

We desire to acknowledge our appreciation of the courtesy and hospitality extended to the members of the deputation, and the valuable information supplied, in the various cities visited, and would recommend that the Town Clerk formally write the various authorities and companies, thanking them.

Manchester.

In Manchester, 56 single-burnered high-pressure gas-lamps of the Keith-Blackman type have been installed. Duplicate compressors, also of the Keith-Blackman type and driven by an electric motor, are housed under the street. The situation of the compressor-house is the reason for having an electric drive—the space available being limited.

We were informed that each high-pressure lamp consumes 25 cubic feet of gas per hour, and yields a light of 1500-candle power. The height of the mantle from the pavement varies from 14 to 16⅓ feet. Some of the lamps are hung from harp-shaped pendants, and some from swan-neck brackets. At midnight, the high-pressure lamps are put out, and a small single-burnered low-pressure lamp of the Graetzin type lighted. There is one of these low-pressure lamps attached by a bracket to each high-pressure lamp pillar. The consumption of gas in these is only 5 cubic feet per hour, and they give a light of 100-candle power each. All these low-pressure lamps are lit by a lamplighter with an acetylene torch. The mantles on the high-pressure lamps are said to last, on an average, one month, and the glass bowl three months.

So far the compressors, motor, and lamps have worked sweetly and well, and have given no trouble, and one man attends to the whole installation. An efficiency of 60 candles per cubic foot is said to be obtained from these high-pressure lamps. The gas is a mixture of coal gas and carburetted water gas; about 16 per cent. of carburetted water gas being used. The calorific value of the gas is given as 600 B.Th.U.

The lamps are spaced about 38 yards apart, and cast-iron pillars are used, having ½-inch malleable iron service-pipes of heavy quality.

A few private firms along the high-pressure gas-pipe route are supplied with gas under pressure for use in their shops and factories.

The high-pressure mains are of 4 inches to 6 inches in diameter, and have turned and bored joints filled with cement.

If the high-pressure lighting system is extended, Mannesmann steel tubes may be used in place of cast-iron pipes.

Birmingham.

In Birmingham, the streets are entirely lit with gas, and the street lighting is under the control of the City Engineer and Surveyor.

About two years ago, experiments were made to test the efficiency of high-pressure gas lighting on the streets; and the Council there are now entirely satisfied with the results obtained, and the extension of this system of lighting will certainly be proceeded with in the near future.

The compressor in use is Messrs. Keith and Blackman's, and three types of lamps are on test—*i.e.*, the Keith-Blackman lamps, the Graetzin, and the Glover. The high-pressure gas is supplied at present through cast-iron mains with turned and bored joints; but possibly steel tubes will be used for future installations. Not only are the Corporation studying the use of high-pressure gas for lighting, but serious attention is being given to the question of town gas under pressure for manufacturing purposes; and as on the routes lit with high-pressure gas ratepayers are encouraged to take a supply from the high-pressure main for such purposes, it is naturally a gain to the Gas Department. A laboratory has also been fitted up with the necessary apparatus, and an expert endeavours to solve the problems of manufacturers, and guide them in selecting and installing suitable high-pressure gas apparatus for the various works—such as brazing, laundry work, enamelling, metal reducing, &c., &c. Manufacturers are permitted certain facilities at one of the gas-works, to enable them to test the efficiency of the apparatus for metal reducing, &c. We had the pleasure of examining these furnaces at work, and were greatly impressed by the nature of the work overtaken by the expert in charge.

London—Crystal Palace.

A large scheme of high-pressure gas lighting was installed at the Crystal Palace during the Exhibition there.

There was, in all, about 200 inverted gas-burner lamps, all of high power—their candle powers ranging from 1500 to 4500; and the lighting effect was brilliant. The figures which we obtained in Manchester as to gas consumption, lighting efficiency, mantles, and glass bowls used were corroborated here by the officials in charge. The rising pipe used for the 4500-candle power lamps is of malleable tube, 1 inch in diameter, and for the 1500-candle power, ¾ inch. Throughout the grounds the height of the lights average about 15 feet. The gas supplied to these lamps is almost entirely coal gas, with a calorific efficiency of 560 B.Th.U. The bye-passes were consuming, on an average, ¼ cubic foot per hour. The work of maintenance and cleaning of 50 to 60 lamps was overtaken by one man.

City of London.

Within the City of London, the evolution and development of high-pressure gas lighting may be traced and studied, as many of the original upright high-pressure burners are still in use. The gain in efficiency since these early installations is easily seen by comparing them with the latest installation of high-pressure inverted burners. At least 100 per cent. more light is now obtained from the same quantity of gas. As in other towns visited, the lamps which have given the best results are mostly of the Keith-Blackman type, but others—such as the Graetzin—are being tested at present. We were given a very interesting demonstration of the working of the suspension gear of the high-pressure gas-lamps suspended over some of the London streets. The gear-boxes are fitted to the house fronts, a key is inserted, and, on winding, the lamp is brought from the centre of the street to a position above the pavement. The gear is then shifted, and the same key lowers the lamp sufficiently near to the ground to allow of trimming, adjusting, and cleaning. For busy, congested streets the suspension of the lamps on a wire or wires seems a desirable thing; and the system in London certainly appears to work well. We were also shown the new low-pressure, high-power lamps which are being tried, and which would be useful in places where high-pressure mains could not be laid down economically. The lamps have for the same consumption of gas about half the lighting efficiency of the high-pressure lamps.

City of Westminster.

Many interesting figures relative to lighting were obtained in Westminster; and in dealing with the question of high-pressure lighting in Glasgow, it would be well to keep in mind the cost to our citizens as compared with the cost elsewhere. Rating of 1d. in the pound yields £24,000 to £25,000 in Westminster, and £20,000 in Glasgow. There are 99 miles of streets to be lit in Westminster, and 400 miles of streets in Glasgow; so that we have actually less money for over four times the mileage of streets. Four miles of streets in Westminster are lit by high-pressure gas lighting; and it is the intention of the Council to gradually extend this system of lighting.

It was interesting to learn that the basis of tender for the lighting of streets was candle power—the Gas and Electric Companies being asked to quote prices for supplying certain specified candle power. Photometrical tests and close inspections are periodically made in the streets.

The lighting is under the supervision of the City Engineer. There are, in Westminster, in all 193 high-pressure gas-lamps, 2719 low-pressure gas-lamps, and 1226 electric lamps. A very valuable table of tests and comparative costs was given to us, which will be of great use in our future workings.

Berlin.

In Berlin, 37½ miles of streets are at present lit by high-pressure gas-lamps, and over 43½ additional miles are to be lit. In 1905, there were only 4½ miles of streets so lighted. The compressors used are of the reciprocating and rotary types; the makes being Graetzin, Pharos, Colonia, and Millennium. Lamps of the same make are in use; and, in addition, other makes, such as Pintsch's, are on test. In Berlin, the quality of gas is eminently suitable for high-pressure lighting; its illuminating value being about 10-candle power, and its calorific value about 500 B.Th.U. gross. Both gas and electric motors are used for driving the compressors; but a gas-motor is the more general. Throughout Berlin gas-mains are being specially laid for this high-pressure lighting; so that it is possible to light up the lamps by increase of pres-

sure, and extinguish two out of three by decrease of pressure. All the compressors in the different works are coupled up to one set of mains. When the compressor motors are going to be started a signal is given by telephone from works to works; so that the lights all over the city are practically lighted up simultaneously. We were given many interesting details regarding such things as pipe-laying; and such points as the jointing of these pipes by lead-wool, driven home by compressed air, was discussed. The value of the low candle-power gas was emphasized by all the gas engineers whom we had the pleasure of meeting in Germany, as was also the desirability of using silk mantles to any other make. High-pressure lamps of the Graetzin and German Welsbach makes were specially commended as the best lamps so far used in Berlin. We were informed that the gas in this city is tested not so much for its illuminating value as for its calorific value. In Berlin, there are 38,821 public lamps; and of these 5400 are at present high-pressure gas-lamps. All-night lighting means 3675 hours per annum, as against 3800 in Glasgow. Half-night lighting (of which we have none) means 1900 hours per annum; and their method of assessing for consumption is to strike a mean for all high-pressure lamps of 2800 hours. The street lighting is under the care of the Inspector of Lighting for the City. The following are some figures relative to candle powers of lamps, height of pillars, and spacing: The 1200-candle power lamp has two burners, and the height of this lamp from the ground is 5½ metres—*i.e.*, about 18·106 feet. The 2100-candle power lamp has three burners, and is 5·7 to 6 metres above the pavement—*i.e.*, about 18⅔ to 19¾ feet. The 3900-candle power lamp has three burners, and is placed at the same height as the 2100-candle power lamp. The spacing of other lamps runs from 30 to 50 yards; and each man is given 60 lamps to fully maintain.

CANNOCK GAS PURCHASE QUESTION.

Some Correspondence and Mr. Hunt's Report.

Much discussion has arisen locally with regard to the proposed application to Parliament by the Cannock Urban District Council for authority to acquire the undertaking of the Cannock, Hednesford, and District Gas Company; and a letter on the matter from Mr. George Helps, of Nuneaton, will be found in our "Correspondence" column to-day. A statement on the subject appeared in the "JOURNAL" for the 2nd inst.; and, in order that the points raised by Mr. Helps may be made quite clear, we now supplement this by the reproduction of two letters which appeared in the Cannock "Advertiser." The first of these was written by Mr. Charles Hunt (who is advising the Council); and it was replied to by Mr. Helps (who was called in by a number of ratepayers to advise them on the question of purchase). There are also appended some facts and figures prepared by Mr. Hunt for the Council; and a brief account of the statutory meeting. When reference was last made to the matter, it was stated that Mr. Helps was adverse to the purchase, on account of the condition of the works and the distributing plant; while Mr. Hunt considered the prospects of the undertaking excellent (not to say brilliant), if only because of the exceptionally good field for increase of consumption.

A LETTER BY MR. CHARLES HUNT.

The following is the letter from Mr. Hunt, written from Westminster, which appeared in the "Advertiser" on Dec. 23:—

Will you permit me to refer, as briefly as possible, to a few of the extraordinary statements made by Mr. George Helps, of Nuneaton, at the recent opposition meeting, as reported in your issue of the 16th inst.? I am sure it would be a bad day for Cannock if these statements were to have the effect they are intended to create.

Mr. Helps is reported to have stated that "he had inspected the works, and in his opinion the whole undertaking showed that it had been governed by most astute men of business, with a view—which no one could find fault with—of getting as much profit as possible out of it before the time arrived for the reconstruction of the whole works." If this intended to convey the impression that the works have not been properly maintained, I deny it entirely. If otherwise, then the words have no meaning whatever. It is quite true that, as stated in my report to the Council, the plant is in some respects deficient in capacity for present requirements—in other words, the requirements have outgrown the plant. This is inevitable at some time or other in the career of an undertaking the output of which is increasing—as in this case—year by year, and is a sign, not of decay, but of progress. Any suggestion, whether real or implied, that the works have not been properly maintained is without foundation.

Mr. Helps says it is necessary to re-pipe the whole area of supply. Why? If because the leakage is as much as 16·17 per cent., what about his own leakage at Nuneaton, which, according to the latest available Board of Trade returns, is as high as 16·69 per cent., though by all accounts the Nuneaton district is less disturbed by mining operations than the Cannock district. It is certainly to be hoped that activity in mainlaying will follow upon the transfer of the undertaking to the Council; but that will mainly be for the purpose of supplying gas to those who are at present without such supply. I anticipate with confidence a considerable increase of consumption from this source, with consequent increase of yearly profit. But I venture to say that there will not be any such extravagance as that which seems to be seriously contemplated by Mr. Helps, for this is quite uncalled for. It may not be without interest in connection with this question to mention that in a recent gas arbitration, where the leakage was not 16 per cent., but 26 per cent., and in which eight gas experts (including the two arbitrators) were engaged, the necessity of re-piping the district was never suggested. A claim was made on behalf of the purchasing authority to cover the cost of certain enlargements and stopping leakage; but this was resisted on the ground that such work was certain to be remunerative, and would therefore repay the purchasing authority to undertake. Similarly, there is an additional profit to be made out of this undertaking. But the question is: Are the works as they stand to-day capable of continuing to earn the present amount of profit? And I say not only that they are, but also that this profit, with judicious expenditure, can be greatly increased.

Mr. Helps is reported to have said that "if the works were mine, I would scrap the lot;" and there were actually those among his audience who applauded this reckless statement. Almost immediately afterwards, however, Mr. Helps, in replying to an inconvenient heckler, was compelled to admit that he would exempt not only the new gasholder but also the retorts from his scrapping process. Now everybody knows that the gasholders and retorts represent much the largest part of the cost of a gas-works equipment; and if to these be added the purifiers (for which larger ones are in course of substitution by the Company), little else remains of the works but comparatively inexpensive plant. So much, then, for Mr. Helps's "scrap the lot" policy, the absurdity of which is further accentuated by the fact—of which Mr. Helps must have been aware if he had properly investigated the matter—that the production of gas per ton of coal carbonized at the Cannock works is 11,605 cubic feet, whereas at Mr. Helps's own works it is not more than 11,540 cubic feet, according to the latest available Board of Trade returns. Why, then, does not Mr. Helps commence his scrapping process at his own works? What value can possibly attach to such criticism?

It is very easy to talk, as Mr. Helps appears to have done, about "up-to-date" plant; but why did he not tell his audience why he considers this particular works to be not up-to-date, seeing that they produce more gas per ton than his own, and that the leakage is less? That some minor improvements in working results are possible the Council are fully aware, and are prepared to introduce in the event of the works passing into their hands, notwithstanding the poor opinion Mr. Helps seems to entertain of the capacity of local authorities to manage gas-works, in which I, with at least as wide an experience of the subject as his, by no means share. There are in the United Kingdom nearly three hundred gas undertakings owned by local authorities; and I venture to say that every one of them is at least as well managed as that of the Nuneaton Gas Company. From what I know of the Cannock Council, I am convinced that the efficiency of the gas service is more likely to be improved than suffer in their hands.

Just one word more. Mr. Helps says he cannot see that there is going to be "any advantage whatever to the present generation from owning the gas-works—the future generation might have it." If that is his honest opinion, I can only say that I am sorry for him. I entirely disagree. I have been concerned in a good many transfers of gas undertakings to local authorities—in none of which, by the by, have I had the pleasure of meeting Mr. Helps—and I cannot recall one in which I could have so confidently recommended a purchase as in this case. The prospects of this undertaking are, in my opinion, excellent—not to say brilliant—if only because of the exceptionally good field for increase of consumption. This is a most valuable asset in the case, but with regard to which Mr. Helps is entirely silent, although he professed at the meeting to be desirous of assisting the ratepayers in coming to a right conclusion. I am firmly convinced that the ratepayers of Cannock would make a very great mistake in their own interests if they were to let the present opportunity for purchase on fair and reasonable terms slip through their fingers.

MR. HELPS'S REPLY.

In his reply (which was published in the "Advertiser" for Jan. 6), Mr. Helps, after referring to other correspondence, said:

Mr. Hunt has for some reason seen well to occupy a column for a purpose which, to me, is little more than that of appreciating his own personal experiences and depreciating mine. The only comment I need make is that it will be more interesting to your readers, and the householders and consumers of Cannock generally concerned in this controversy, if he will drop personal equations and deal with this matter by a parade of facts and arguments rather than of persons.

Now, in regard to the impersonal matters Mr. Hunt refers to.

Nuneaton Leakage.—Mr. Hunt's figure is not only incorrect, but he has failed to state something which he must know—viz., that the pressures at Nuneaton are high pressures, and that therefore no comparison of leakage can be made as he attempts to make it. Cannock supplies gas at 2 or 3 inches of water pressure; whereas Nuneaton supplies gas up to 10 lbs. or more per square inch. Obviously where mains are unsound a pressure of 2 or 3 inches will not account for as much leakage as a pressure of 270 inches. Again, Nuneaton affairs have nothing to do with the case; but perhaps the reference is interesting as a measure of the value of Mr. Hunt's arguments.

Maintenance of Works.—Not once did I refer to maintenance. I did refer to up-to-dateness—a totally different matter.

Mains.—I referred to leakage and pressure. If Mr. Hunt is reporting to the Council that the mains are in a satisfactory state to meet the demands of the district, I should like to ask him if he has taken, or caused to be taken, the pressures throughout the district during the heaviest hours of consumption; and, if so, what the pressures at the various consumers' houses were. Was the pressure adequate throughout the district?

Scrapping.—I did not mean to exclude the retorts from the scrapping process I referred to. If Mr. Hunt does not agree with me as to the wise policy of scrapping the present works, perhaps he will be good enough to answer the following questions:—

(*a*) Is gas being manufactured at the Cannock Gas-Works, considering its proximity to the gas-coal fields and railway, as cheaply as at any other works in the kingdom with the latest and best equipment of up-to-date manufacturing plant?

(*b*) Is gas being distributed to Cannock, Hednesford, and district through the best type of mains for a mining district, and at a pressure that allows all the consumers to obtain a sufficient supply at all their burners, &c., whenever they require it, so that they may use it to the best advantage?

(*c*) If the leakage were reduced, should not the consumers be given the benefit of the increased saving effected?

(*d*) Who pays for the leakage—the consumer or the shareholder? If the shareholder, why? [I cannot believe that Mr. Hunt would advise the Council, if they purchase the gas-works concerned, to carry on the manufacture and distribution of gas for any period with the existing plant, &c., as it is.]

(*e*) According to Mr. Hunt's argument, if the leakage in Cannock, &c., were 25 per cent., or even 50 per cent., of the gas made, the

mains would be just as valuable as they would were the leakage but nominal. Is this Mr. Hunt's serious opinion? [Surely such reasoning is rather "extraordinary" and "reckless."]

(*f*) Assuming that the Cannock Gas-Works was in the most up-to-date condition for the manufacture of gas in quantities as required to-day, and also so set out that suitable extensions could be made for increased output, would he value it as a going concern at his present figure only?

(*g*) Will Mr. Hunt inform us how much of the existing works and plant he would expect to find in use in 10 or 15 years' time if the Council decide to purchase?

These and other points may have been dealt with in Mr. Hunt's report. In my opinion, they are of the utmost consequence, and such matters as the ratepayers and householders of Cannock might know without prejudicing any negotiations for the purchase. In my opinion, I have endeavoured to point out that by far the most important asset is the right to supply the district with gas. Whatever the figure paid for the undertaking, something like £30,000 will have to be expended almost immediately, and, in addition, £10,000 provided for working capital. Certainly the supply of the district could be carried on for some time to come by spending money on the existing plant and mains; but such a proceeding would not be in the interest of the Council or the gas consumers. All increased costs of such faulty management and working would have to be borne by the consumers or the ratepayers as the case might be.

Mr. Hunt has always had my respect as a gas engineer and as a man. I cannot readily bring myself to adopt any attitude of belittling his position or his work; but I hope he will strictly adhere to the spirit and meaning of my statements and the facts concerned, and meet them with what other statements and facts he desires, or, in other words, play cricket.

A Statement Prepared by Mr. Hunt.

As Mr. Hunt's original report on the subject of purchase was too lengthy and complicated for publication, the Gas Committee asked him to prepare a short statement of facts and figures, founded on that document, in such a form that the grounds of purchase could be easily understood and considered by the electors—the original report, at the same time, to be open to inspection by ratepayers. Mr. Hunt complied with this request as follows—

As to the apprehension which appears to exist in some quarters lest the terms of purchase agreed between the Council and the Gas Company should prove a burden on the rates or necessitate an increase in the price of gas, I should like to point out that the published accounts of the Company show that in each year, for the last four or five years, a profit has been made in excess of the amount required to pay their statutory dividend. This is really an answer to the gentleman who, at the recent opposition meeting, suggested that 7 per cent. on £40,000 was only 3½ per cent. on £80,000. Until the passing of their new Provisional Order last year, the Company were precluded from paying more than 7 per cent. on £39,000, or £2730 per annum. That was the utmost extent to which they might go in distributing the profit among their shareholders. But the actual profit made in 1910, as shown by the revenue account for that year, was £3756, or £1026 more than sufficient for the dividend, although the expenses for that year included a quite exceptional amount of £135 for law charges. Moreover, there is also included in the expenses a sum of £957 for depreciation, written off "plant, meters, &c." It is a debateable point as to how far a company is justified in thus writing off for depreciation, since, having regard to their obligation to repair and renew out of revenue, such writing off, in addition to repairing and renewing, reduces capital at the expense of revenue—in other words, creates capital out of revenue. Personally, I am not disposed to draw the line tightly in this respect, because it is clearly a wise thing to keep down capital if it can be done without injustice to other interests. For the purpose, however, of ascertaining the value of an undertaking with a view to purchase, one is bound to take these writings-off into account in determining the amount of profit earned. In such case the usual practice is to adjust the actual expenditure upon repairs and maintenance by a figure, which, according to general experience, should suffice over an average of years to provide not only for repairs and maintenance, but also for renewals as they fall due. This figure is usually somewhere between 5d. and 7d. per 1000 cubic feet sold; and I have allowed for an average expenditure of 6½d., in confirmation of which figure may be instanced the experience of an undertaking, of which I am Consulting Engineer, where every year a sum representing 6d. per 1000 cubic feet sold, or ½d. less than I suggest as the proper amount in this case, is put aside for repairs, maintenance, and renewals. This amount more than suffices to pay all the charges for maintenance and repairs, and there is a balance remaining at the end of each year; so that there is now accumulated a substantial amount available for renewals as these become due. As the actual expenditure of this Company in 1910 on repairs and maintenance—cash out of pocket, so to speak—was less than 6½d. per 1000 cubic feet, I made a deduction on that account from the £956 written off; and this leaves £692 to be added to the profit for the year. I also add Directors' fees, £293 10s., as these would be saved if the purchase be carried through. The account, therefore, stands thus:—

Profit as per revenue account	£3756 0 0
Add depreciation written off	956 0 0
Add Directors' fees	293 10 0
Total	£5005 10 0
Deduct underspent on repairs, &c. . . .	264 0 0
Leaves	£4741 10 0

as the amount available for interest and sinking fund.

Reckoned at 3½ per cent., and repayable in forty years, this amount would be sufficient to cover a loan of more than £95,000, whereas the sum required to complete the purchase is only £72,000, *plus* bank overdraft and parliamentary expenses. It is clear, therefore, that on this basis not only can there be no burden on the rates, but that in the very first year there will be a surplus of profit after paying all expenses, to say nothing of the additional profit which will in all probability have accrued since 1910. I see nothing to prevent the sales of gas from doubling in the next ten or twelve years, in which case the profit should also continue to increase.

It may be some guide to those who are inclined to think that the Council might have done better by referring the matter to arbitration, if I mention that the latest arbitration result—relating to the Swinton and Mexborough undertaking—works out at 25·75 years' purchase of the authorized dividend, *plus* costs of arbitration, which may be easily run to some thousands; and this for a works having the workable gasholder 10 inches out of level through mining operations, with 26 per cent. of leakage, and other minor defects. This compares with 26·37 years' purchase to be paid in this case, with no arbitration expenses. It may also be mentioned that in a recent gas arbitration, in which the award was £137,150, the expenses of one side alone amounted to over £7000.

The Statutory Meeting and Another.

The statutory meeting of ratepayers to consider the promotion of the Bill was held in the Hednesford Drill Hall on the 8th inst., when the attendance, it seems, was "somewhat disappointing." The proceedings, however, lasted three hours; and at the end of this time, the resolution for the promotion of the Bill was lost by a large majority. The meeting was presided over by Mr. J. Hunter, the Chairman of the Council; and Mr. Charles Hunt, who was present, replied to a number of questions. The Clerk to the Council (Mr. C. A. Loxton), in the course of an exhaustive statement, dealt with the different features of the matter, and explained that it had been decided (if a poll was demanded) to hold two meetings—the statutory one, which was then taking place, and one at Cannock. Opening with a historical sketch, he went on to consider three questions: (1) Should the Council buy at all? (2) Is the price reasonable—will it pay? (3) What are the prospects for the future?

On the 17th inst, a meeting was held at Cannock New Hall; and again the attendance was adversely affected by the weather. Mr. Loxton addressed those present, among whom were some very active opponents of the scheme. He said he recognized that the ratepayers had a perfect right to discuss the matter; and it had been suggested time after time that it would be a good plan if Mr. Helps would meet Mr. Hunt and talk things over. Moreover, an alternative was also offered—that six of the opposite party should meet six of those in favour of the purchase, and discuss the question. Neither of these suggestions had been accepted by the opposition. He dealt with the various objections that had been raised to the proposal, and subsequently Mr. Whitehouse, who stated that he had been a member of the Gas Committee for twelve months, urged the ratepayers to purchase the works, because he believed it would be in the interest of the people of the district. The meeting not being the statutory one, no resolution was submitted; but a large number of questions were asked and answered.

A special meeting of the Council was held last Friday, when it was stated that the members, sitting as the General Purposes Committee, resolved unanimously to recommend that a ballot of the electors be taken with regard to the purchase. In the course of some discussion, the opinion was expressed that Saturday next, the 27th inst., would be the most convenient day for the poll; and this date was agreed to.

Stockport's New Reservoir.—The heavy rainfall which preceded the snowfall last week had the effect of completely filling the large reservoir just finished for the Stockport Corporation in the Kinder Valley. The overflow began on Tuesday last, and by Thursday it was calculated that it had reached 18 million gallons.

Reduction in Price.—The Ilfracombe Gas Company announce a reduction of 1d. per 1000 cubic feet in the price of gas, to take effect from the 25th of March next. It will be accompanied by rebates for prompt payment ranging from 2d. per 1000 cubic feet for a consumption not exceeding 20,000 cubic feet to 6d. per 1000 cubic feet for 80,000 cubic feet or more. This will make the net price 3s. 4d. to small consumers and 3s. to the largest ones.

Paper-Bag Cooking on the Gas-Stove.—The advantages of the ordinary gas-cooker in connection with the latest mode of preparing dishes, by means of paper bags, were demonstrated on Monday evening last week, in the show-rooms of the Alliance and Dublin Gas Company, where Miss A. Mahalm from three to five o'clock opened a fortnight's series of lectures on this subject. The lectures will be continued at the same time each afternoon, and from 7.30 to 9.30 in the evening. The audience on the opening day was exclusively of ladies. Miss Mahalm cooked on a No. 120 cooker, among several dishes, vegetable soup, filleted plaice, omelettes, and roast duck. The lecturer, in the course of her remarks, said a great many mistakes were made in paper-bag cookery by having the oven too cold. It was far better to have the temperature high, because the joint would be cooked and suitably crisped in less time.

Tavistock District Council and the Water-Works.—A public meeting held at Tavistock last week unanimously passed a resolution endorsing the action of the District Council in promoting a Bill for the purchase of the water-works, markets, &c., from the Duke of Bedford. Mr. R. D. Doble, the Chairman of the Council, said that, acting on the advice of the Local Government Board, they had secured the services of a water engineer, and Mr. Frank Howarth, M.Inst.C.E. had made a long and able report. In the draft agreement prepared by the advisers of the Duke of Bedford, it was proposed that the income of the water undertaking which might be made in future should be taken into consideration for the purposes of valuation. The Council could not think of consenting to this condition, which was based upon the anticipation that they might charge more for water in the future than they had been charging in the past. The Bill provided that the Duke "shall sell, and the Council shall purchase," the water undertaking; and as to the other public properties, that the Duke "may" sell and the Council "may" purchase. They were to buy on the net maintainable revenue on the average profit of the undertaking; and fifty years was named as the period for the repayment of the water-works loan. The revenue would be sufficient to meet the interest and repay the proportions of the principal which would be due each year.

ASHBOURNE GAS-WORKS PURCHASE QUESTION.

Ratepayers in Favour.

In connection with the proposal of the Ashbourne Urban District Council to purchase the Ashbourne Gas-Works, a crowded meeting of ratepayers was recently held in the Town Hall—Mr. T. H. B. Bamford, J.P. (Chairman of the Council), presiding.

The CHAIRMAN gave various reasons why the town should profit by the present opportunity of purchasing a most remunerative undertaking. He explained that the Gas Company had obtained a Bill giving them powers which the Council, as guardians and protectors of the ratepayers, had opposed. The Council had also secured powers to purchase the concern; and it now rested with the ratepayers to decide whether or not they should do so. The profits of the Company, according to the evidence of their own engineering expert, were £1000 annually; and by multiplying this sum by 22, representing the average number of years' purchase usually awarded, they would get somewhere near the probable purchase price. In order to be liberal, however, he would put the annual maintainable profits at £1212, which would bring the price up to £26,664. With regard to the loan, this could be obtained at £4 12s. per annum for principal and interest; and this, he believed, would enable the town to make a profit from the first year. He was firmly convinced that the purchase would not increase the rates a single halfpenny; while, on the other hand, the concern would in time contribute large sums to the relief of them. In support of his statements, the Chairman quoted several municipalities who had taken over the gas supply, and were reaping considerable benefit. In conclusion, he moved: "That this meeting of the parochial electors of the urban district of Ashbourne is in favour of the promotion of the Ashbourne Urban District Council (Gas) Bill, 1912, which has been deposited in Parliament by the Council."

Rev. Canon MORRIS seconded the motion.

Mr. J. OSBORNE, J.P., opposed the motion; contending that the undertaking could not be purchased for anything like the sum mentioned by the Chairman, and that either it would be an extra burden on the rates for many years or the price of gas would have to be increased, which would be almost as injurious to the town. His own idea was that the project would cost the Council £45,000, including expenses. There were, he thought, only two reasons to justify the purchase—viz., if they could be assured that the price and terms were reasonable, and that the rapid development of the town would take place; and he contended that both were very unlikely.

Remarks having been made both against and in favour of the purchase, the motion was put by the Chairman, and carried by an overwhelming majority.

SOUTH METROPOLITAN LIGHTING STAFF DINNER.

Co-Partnership Benefits—Public Lighting of Camberwell.

The Sixth Annual Dinner of the staff of the Public Lighting Department of the South Metropolitan Gas Company was held at the Surrey Masonic Hall on Friday, the 12th inst.—Mr. H. TALBOT in the chair. Among those present were Mr. Charles Carpenter, the Chairman of the Company the Mayor of Camberwell (Alderman W. Brenchley), and Mr. Councillor Newton.

After the usual loyal toasts had been honoured,

Mr. J. F. COLLINGS proposed "The South Metropolitan Gas Company." He pointed out that the Company was now governed by an ideal Board of Directors, whose sole object was the improvement of the business and the welfare of the employees. He recalled the institution of the co-partnership scheme, which, he said, had proved of inestimable benefit to all connected with the undertaking, as they were shareholders and capitalists to the extent of £301,490.

Mr. C. W. SACKETT replied; and, in the course of an interesting speech dealing with the system of co-partnership, said it was a matter of satisfaction to the employees to know that the principle had achieved such wonderful success. He thanked the Company for the facilities they had granted the deputation who had waited upon members of Parliament with regard to the effect which the Insurance Act would have upon the sick club of the Company. Unfortunately, the suggestions then made were futile. The Company were prepared to submit schemes for the approval of the Insurance Commissioners which would result in greater benefits being conferred upon the members of the club. It was then admitted that the scheme was one of the best; yet after three hours' discussion the proposals were defeated by party politics. Reverting to the subject of co-partnership, the speaker declared that it would put an end to the industrial warfare existing at the present time. When they fully realized the number of benefits received through the system, and the many advantages they obtained by it, on the one hand, and looked at the economic discontent of the great mass of their fellow-workers, and the grasping methods adopted by many employers, on the other, the employees of the South Metropolitan Gas Company had indeed something to be thankful for.

The toast of the "The Chairman" was next proposed by Mr. T. LEWIS, and received with musical honours.

The CHAIRMAN having acknowledged it,

Mr. W. A. MILLS proposed "The Visitors;" coupling with it the names of the Mayor, Mr. Charles Carpenter, and Nr. Newton.

The MAYOR, in responding, said he had always taken a very great interest in the subject of street lighting. He recalled the fact that he had the privilege of meeting the late Sir George Livesey in 1898, when he (the speaker) was a member of one of the Committees of the old Vestry of Camberwell. The question was then being considered of converting the old system of flat-flame lighting to the incandescent method. Sir George Livesey came to the Town Hall and submitted certain proposals for providing "new lamps for old ones." At that time there were 4104 lamps in the borough, which gave 60,000-candle power. When it was remembered that there were something like 135 miles of roads in the borough, it would be recognized how large was the amount of lighting spread over so extensive an area. The change in the system had resulted in the cost of lighting in the borough being reduced. In 1910, the number of lamps in Camberwell had increased to 4555. The annual cost of lighting in 1898 was £12,891; but notwithstanding the increase in the number of lights, the expenditure at Lady Day, 1910, was only £12,041—a decrease of no less than £850. In 1898, the candle-power of the lamps of the borough was 60,000; but in 1910 it had reached 273,180, or an increase of 350 per cent. in the lighting, despite the reduction in cost. The cost per mile of lighting of the borough in 1898 was £100; last year it was £91. When it was remembered that the electric lighting system of Marylebone cost £340 per lighted street, it would be seen that Camberwell was effecting a great saving in the lighting system of the borough.

Mr. CARPENTER, replying to a remark made by a previous speaker that the Company were losing money by the lighting system they had provided for Camberwell, said they were not out as philanthropists, and he could assure the Mayor and the councillors of Camberwell that the Company were not losing money by the project.

Mr. NEWTON also responded to the toast. He said, as one of the members of the Borough Council, he could state that Camberwell appreciated all that was being done to improve the lighting of the locality.

The speeches were interspersed with songs and musical selections.

SEDGLEY DISTRICT COUNCIL AND GAS-MAINS.

Question of Litigation.

The Clerk of the Sedgley Urban District Council (Mr. T. R. Knight) has written to the Surveyor of the Coseley Council on the subject of gas-mains in two of the thoroughfares in Upper Gornal. He states that many years ago one of them (Eve Lane) was divided transversely for highway purposes; and since that time the Coseley Council have acted as the highway authority over the lower half and the Sedgley Council over the upper half. The other thoroughfare (Burton Road) formed part of the old turnpike road from Wolverhampton to Dudley, and in about 1869 an Order was obtained dividing it transversely; and the division has since 1888 been fully recognized by the County Council. The Bilston Gas Act of 1846 conferred upon the Company powers to supply "the township of Bilston, in the parish of Wolverhampton, and the villages of Brierley and Coseley, in the parish of Sedgley." No mention was made of Woodsetton or of any other of the several villages then included in the parish of Sedgley.

A short time ago, the Gas Company, without the consent of the Sedgley Council and without giving notice, commenced opening the roadway over which the Council are the highway authority. The Council therefore gave notice for these operations to be stayed; and this was accordingly done. The whole matter was afterwards fully considered; and the opinion of Mr. Macmorran, K.C., was obtained thereon. It was in every way favourable to the Council, who were advised to commence proceedings for an injunction. The Council, however, were not satisfied that the matter was of sufficient importance, and they had no desire to commence litigation. They had accordingly entered a protest against the Company's action, and reserved a reconsideration of the matter if occasion requires.

With regard to the Counsel's mains in Burton Road, when they purchased their gas undertaking a considerable length of main was situated outside the urban area, and had since been rated to the Coseley Council. The Burton Road was one of these; and though, as was contended by the Surveyor, one-half of it was in the Coseley area, the Sedgley Council, as the highway authority, had for many years maintained a service of public lamps along the road without receiving any contribution from Coseley.

LIGHTING COMPANIES AS SOCIAL REFORMERS.

Under this heading, the following remarks appear in the number of the "Illuminating Engineer" of New York for the present month.

The question of old age pensions is a live political issue in Great Britain; but in America the subject is being practically taken up by the various large industrial corporations. In this work none have been more active and progressive than the lighting companies. Not only the pension system, but the general welfare of the employees, was made the subject of a special session of the National Electric Light Association at its convention last June. As this Association now numbers more than 10,000 members, and represents more than 90 per cent. of the money interest in the production of electricity in America, the extent of its power for promoting social reforms may be appreciated.

The most recent case is that of the Consolidated Gas, Electric Light, and Power Company, of Baltimore, which at the meeting of the Board of Directors on the 6th ult. adopted a plan to pension: "(1) Any employee who attains the age of 65 years after 15 years' continuous service. (2) Any employee who, after 20 years' continuous service, is, by reason of permanent physical or mental disability, unable to follow his usual employment in the Company's service. (3) Any employee after 10 years' continuous service who shall become incapable of continuing in service by reason of injuries received while at work in the employment of the Company."

The detailed plan for the application of the pension principle to the classes above mentioned is such as to result in very liberal treatment of the Company's employees. It is provided that the entire cost of the pension system shall be borne by the Company—no contributions from the employees themselves being called for.

During the hearing of a prosecution by the Gaslight and Coke Company at Marylebone last Wednesday, it was stated that some 2000 of the Company's prepayment gas-meters were broken open and robbed every year, but only in about 2 per cent. of the cases were the thieves caught.

ABERAVON AND MARGAM GAS ARBITRATION.

First Day.

The hearing was commenced last Tuesday, and continued on the following days, at the Surveyors' Institution, Great George Street, Westminster, of an arbitration to determine the price to be paid by the Margam Urban District Council for such portion of the Aberavon Corporation gas undertaking as is within the area of the Council. The proceedings arose out of an Act obtained by the District Council last year.

The Arbitrators were Mr. CORBET WOODALL, for the Aberavon Corporation, and Mr. HARRY E. JONES, for the Margam District Council. Mr. A. J. RAM, K.C., acted as Umpire.

Mr. BALFOUR BROWNE, K.C., and Mr. A. WEDDERBURN, K.C. (instructed by Mr. M. Tennant, the Town Clerk, and by Messrs. Sharpe, Pritchard, and Co.), appeared for the Aberavon Corporation; while Mr. HONORATUS LLOYD, K.C., and Mr. VESEY KNOX, K.C. (instructed by Mr. D. E. Jones, Solicitor, and Clerk to the Council, and by Messrs. Lees and Co.), represented the Margam Council.

The Case for Aberavon.

Mr. BALFOUR BROWNE, in opening, said that Aberavon owned works which supplied gas within the area of the Corporation, and also within part of the district of the Margam Council. There was a portion of Margam which was not included in the Aberavon lighting area. There was another area—Michaelstone Lower—in which Aberavon had certain lighting rights; but in the present case what they were concerned with was the part of the Margam district supplied by Aberavon. Last year, Margam applied for an Act to compulsorily purchase the part of the Corporation's undertaking which was within the District Council's area; and they obtained it. In the preamble to the Act it was stated that, by the Aberavon Local Board Act, 1866, the Corporation were authorized to supply gas throughout the borough; and by the Aberavon Order of 1884, the limits for the supply of gas by the Corporation were extended to include the hamlets of Hafod-y-Porth and Michaelstone Lower. The district which included the hamlet of Hafod-y-Porth was constituted a local government district in 1884, after the Aberavon Order had been made. Since its constitution, the district had greatly developed, owing partly to the construction of the Port Talbot railway and docks and the erection of steelworks; and the population had largely increased. Its population and rateable value now exceeded that of the borough of Aberavon. The preamble of the Act continued: "Whereas a large portion of the hamlet of Hafod-y-Porth within the limits of supply of the Corporation is without a supply of gas, and there is no company or person authorized to supply gas throughout the remainder of the district, and it is expedient that the supply of gas throughout the whole of the district should be in the hands of the Council, and that the Council should be authorized to acquire so much of the gas undertaking of the Corporation as is within the district, and that they should be authorized to erect new gas-works for the supply of the district and to acquire lands therefor." Section 3 incorporated with the Act the Lands Clauses Acts (except section 127 of the Lands Clauses Consolidation Act, 1845); and it was under these Acts that the arbitration was taking place. One part of section 4 he must read: "The expression 'the gas undertaking of the Corporation' means the portion of the gas undertaking and plant of the Corporation within the district, and all the rights, powers, and privileges, if any, vested in, or belonging to, or had, or enjoyed by, the Corporation within the district in relation to the manufacture, sale, and supply of gas, and shall include all mains, pipes, meters, stoves, cookers, or other apparatus laid, or erected, or used by, and belonging to, the Corporation within the district at, or after, the passing of this Act, but prior to the date of transfer. 'The date of transfer' means the date at which the gas-works undertaking of the Corporation is by this Act transferred to the Council." The operative part of the Act was section 6; and this provided, among other things, that within six months after the passing of the Act, the Council should give notice to the Corporation of their intention to purchase. It also stipulated that the purchase money, when received by the Corporation, should be applied by them in the repayment of any outstanding moneys borrowed by the Corporation for gas-works purposes, or to such gas-works purposes to which capital was properly applicable, or in such other manner as might be approved by the Local Government Board. With this, however, they had now nothing whatever to do. It seemed to him it was a simple case they had to deal with. It was quite obvious that what had to be valued was a portion of an undertaking as an undertaking. The addition of the words "with all rights, powers, and privileges," made it clear that the Corporation were not only to be compensated for the physical structure, but for the loss of a commercial undertaking. The most recent deliverance upon this subject was in an Irish case, where "all rights, powers, and privileges" being transferred, as they were here, was held to compel a valuation as a going concern—that was to say, as a revenue-producing undertaking. It must be valued upon the maintainable income. In this case, instead of troubling the tribunal with figures supplied by two accountants, the parties had agreed that one well-known gentleman should prepare tables; and therefore on the figures there could be no dispute. They would be proved by Mr. Cash, who would attend not for examination and cross-examination, but merely to put in the figures and furnish any necessary explanations. The series of tables prepared by Mr. Cash began with one which showed that the amount of capital that had been expended at March 31, 1911, was £40,163. A certain amount had been paid off; and the sum outstanding at that date was £30,689. In the table setting forth the purposes for which the money had been expended, the only matter to which he wanted to call special attention was in connection with a large item on Aug. 12, 1910—"Mains, chiefly in the Margam district, £2500;" and the amount of the loan unredeemed on March 31, 1911, £2500. This sum had been expended for the Margam district by the Corporation, and was not yet remunerative. The mains were laid down for future requirements; and the future was being taken away from the Corporation through the action of the Council in promoting their Bill. The Bill was opposed by the Corporation, who were not acquiescing sellers, because they saw that the growth was very rapid all round. The next table showed the adjusted revenue account for five years ended March 31, 1911. This indicated that the profit had gradually gone up. For the year 1907, the profit was £1905. Next year it was £1487; and from that time there had been a steady increase, until they found practically the same amount of profit in 1911 as in 1910. For the account year, the amount was £3519. For several years after the Corporation originally purchased the works, the undertaking was carried on at a loss; and the sum which had to be contributed out of the rates had amounted to several thousand pounds in all. It was a hardship, of course, for the ratepayers of that time that they should have had to put their hands in their pockets; but he did not think, strictly speaking, that the Corporation could make any claim for the losses. It was the value now of the undertaking that was being transferred; and though it had been suggested that the purchasers ought to make good to the ratepayers of Aberavon their losses in the past, he did not think this was an element of claim which he could put before the tribunal. Mr. Cash's figure of £3519 gave them a basis from which they could make a start. Then there was an analysis of the profit on working, which came to 18·17d. per 1000 cubic feet in the account year. The only adjustment that had to be made in this figure was that, in the particular year referred to, there was not a sufficient sum spent on repairs and maintenance; and therefore, instead of starting with a profit of 18·17d., they would take a calculated figure of 17·73d. per 1000 cubic feet—making the adjustment for the amount that ought to be added for repairs and maintenance, to bring out a true figure. In the table dealing with the income from sale of gas, meter, cooker, and prepayment fittings rental, the two districts were divided. The total gas-rental in Aberavon was shown there to have increased from £2434 in 1902 to £4349 in 1911, which was practically the same figure as in 1910. If they looked at the gas-rental in Margam, they would find that this had increased even more rapidly; the amount having gone up from £1273 to £3610. Taking the total gas, meter, cooker, and prepayment fittings rental, the increase in Aberavon was from £2557 to £4688; and the growth in Margam was from £1350 to £3908. This went to prove that Margam was increasing really more rapidly than the Aberavon district. In the following table, again, the two areas were separated. Here it was shown that the gas sold in the Aberavon district had gone up from 13,618,000 cubic feet in 1902, to 25,638,000 cubic feet in 1911—or had practically doubled; while in Margam the sales had increased more than three times—from 6,341,000 cubic feet to 20,865,000 cubic feet. Going back again to the table giving the analysis of the working profit, and taking the adjusted figure of 17·73d. per 1000 cubic feet of gas, and applying it to the quantity sold in Margam, they arrived at an income from the sales of £1541. Now they came to the question of how this ought to be capitalized; and the Corporation said that this particular case, having regard to the security, should be placed upon the 3¾ per cent. table—that was, 26¾ years. This gave a figure of £41,093. The matter did not, however, end here. This figure, if the multiplier was right, showed the value of the undertaking in the year ending March 31, 1911; but what Margam was taking from Aberavon was an instrument that could earn more than this, and the future had to be looked to as well as the actual account year. Fortunately, there was something to go upon since the account year. So rapid was the growth of Margam, that they had sold a large amount of gas in excess of what was shown in the account year. The profits, of course, were only based upon what they could supply with their present powers, because his own idea was that one could not take into consideration—could not speculate upon—the possibility of Parliament giving one an Act. But in this particular case, the Corporation had a certain amount of capital unexpended; and with this they could have earned a considerable amount more than in the account year. The prospective profits which the Corporation claimed were based upon an increase of 8 million cubic feet in the next year after the account year; and to this they applied the same figure of 17·73d. per 1000 cubic feet, multiplying the result by 26¾ years, which gave them £15,760. This would be the increase for the one year which the unexpended capital would cover. After then the capital would be exhausted. If they had had sufficient capital to go on extending for a second year, he would claim higher prospective profits. He was speaking of Margam alone.

Mr. HONORATUS LLOYD: That is an increase of 40 per cent.

Mr. BALFOUR BROWNE: It is remarkable; but you will find that they are remarkable people. Continuing, he said they could refer to the actual amount of gas that was being sold to-day. Under clause 4 of the Act, the Corporation had a right to calculate up to the date of transfer. It seemed to him that it was rather an extraordinary provision; but he relied very strongly on the words in the clause as giving him the right to look at the value of the undertaking as at the date of transfer—namely, three months after the award. Under the Lands Clauses Act, it was usually the date of notice to treat that was important. He had not seen in any other Act the words in section 4. The two figures which together were the maintainable profit—£41,093 and £15,760—gave a total of £56,853. Now he came to what, so far as he could see, was the only difficulty in the case. The manufacturing works were in Aberavon; and the mains, &c., were the only things in the Margam district. What introduced an element of complication was the fact that the Corporation would be left with surplus works on their hands which they could not transfer, because they were part of their own undertaking in Aberavon; and these works were at present of no use to the Corporation. The difficulty was to find out when Aberavon would have grown to such an extent as to be able to utilize these surplus works. When they could be utilized, they would become valuable to the Corporation; but in the meantime they were in the nature of a "white elephant," which had, however, to be maintained. They had calculated the rate of growth in Aberavon, and had come to the conclusion that these surplus works would be required to meet the demands of the district in seven years. The value of the works for which they had no present use was £11,546; and, discounting this sum back for three-and-a-half years, upon the 3¾ per cent. table, a figure of £10,150 was arrived at. Deducting this from the £56,853, left a sum of £46,703, which he

contended was the real present value of the portion of the undertaking which was to be transferred under the Act. Of course, the surplus works would come into use gradually, as the consumption grew; and this was the reason for the discounting back. Then to the £46,703 should be added 10 per cent. for compulsory sale (£4670), making £51,373. The only other item was the increased cost of working that would be involved by reason of the reduction in the output. If 28 million cubic feet was knocked off the output, it would be impossible to reduce the cost of working proportionately. On this head the Corporation claimed £490, making a total of £51,863. In conclusion, he knew of no other method than the one he had outlined of valuing a part of an undertaking such as this. Of course, where there was no revenue, another plan had to be adopted; but in a going concern it was the revenue which had to be considered.

EXPERTS' EVIDENCE.

Mr. *William Cash* was then called, and explained the figures in his tables and the method adopted in arriving at them. Ordinary meters were charged to revenue until the year ended March 31, 1904. Since that time they had been charged to capital account at the full cost. The purchase of prepayment meters did not begin until 1902; and since 1907 these had been charged to capital. He had adjusted various items, amounting to £406, which accounted for the difference between the capital expenditure according to his table and the figure appearing in the books of the Corporation. The capital expenditure since the date to which his tables were made up (March 31 last), up to Dec. 31, was £2678. Of this, £417 had been spent on additional retorts; and at the present moment there was no specific sanction for the borrowing of this money. But, of course, the Corporation had unexpended balances of loans, and had sanctions for additional loans, but not for this particular object. On March 31, the Corporation had at the bank on loan account £2980; and they had loans authorized, but not taken up, he understood, to the extent of £1680. There was no charge as provision for depreciation in respect of ordinary and prepayment meters, cookers, prepayment fittings, automatic lighters for public lamps, and office furniture. He had made a calculation of depreciation for these items. Bad debts were remarkably small. The decrease in the profit last year was largely due to an alteration in the price of gas for lighting, from 4s. 2d. to 3s. 6d. per 1000 cubic feet. The price of gas for cooking and heating was put up; and the consumers were supplied from that time by one meter. Certain consumers in Margam had cookers on hire-purchase; and these might be treated as debtors for the amount owing—the purchasing authority taking over the uncollected portion of the uncollected payments. They would have the security of the cookers themselves if any debtors failed to complete their payments.

Mr. *William Newbigging*, in answer to Mr. WEDDERBURN, said he gave evidence when the Bill was before Parliament, and had seen the works and the area of supply. The firm of which he was a member constructed the new works in Aberavon, which were built in 1907. In 1905, the sale of gas was very nearly 25 million cubic feet; and it was clear that there would be developments. He therefore advised that steps should be taken to erect manufacturing and purifying plant on a site which the Corporation bought—that they should move the works from the old site to the new one. On the old site, there was still a holder which was usable, if not at the moment actually in use; but the other plant was not maintained after it was decided that the new works should be built. The buildings remained, and were used for the purposes of the Corporation. The total capacity of the existing works would be between 60 and 70 million cubic feet. The additional amount of gas sold, compared with the corresponding period of the previous year, in the Margam area in the three quarters since March 31 last was: March to June, 964,290 cubic feet; June to September, 2,657,151 feet; September to December, 2,326,527 feet. So that the total increase in Margam in the three quarters was about 6 million cubic feet; and adding 2 millions for the December to March quarter, they would arrive at the increase of 8 millions to which Mr. Balfour Browne had referred, and which was rather below than above the mark. Compared with other similar places, the price charged for gas in Aberavon was moderate. The profit made on the working as shown by Mr. Cash was 18·17d. per 1000 cubic feet; but he (witness) had reduced this figure, because his view was that sufficient had not been allowed for repairs, maintenance, and renewals of works, mains, meters, &c. The allowance originally made for repairs and renewals was 5·56d. per 1000 cubic feet; and to this he added 1·44d.—making 7d. in all. This reduced the profit of 18·17d. per 1000 cubic feet to 16·73d. Taking this figure, he had prepared a valuation, in which he took a capitalized maintainable profit of £1454 per annum on the 3¾ per cent. table—giving £38,773. He adopted the multiplier of 26⅝ years, because in his opinion the Corporation should have such a capital sum as they could invest at 3¾ per cent. to yield an income equal to that which they were surrendering. He took the prospective profit as £558, based on an increased sale of 8 million cubic feet per annum, and applied to it the same multiplier, which gave £14,880. When the severance took place, the Corporation would have on their hands more works than they would know what to do with; but as the gas consumption increased, they would by gradual stages be able to use the whole of the works. This matter he had dealt with by multiplying 28,865,000 cubic feet by £400 per million, which gave £11,546. The 28,865,000 feet was the 20,865,000 feet sold for the year to March 31 last, *plus* the 8,000,000 feet increase for the present year; and the £400 was the cost of the works per million cubic feet sold. He assumed that it would take Aberavon seven years to bring into operation the whole of the works; but they would gradually come into use, and he had averaged the total and partial use, and deferred the £11,546 for three-and-a-half years, which gave £10,152. Deducting this amount from the previous figures left £43,501, to which he added 10 per cent. for compulsory purchase, making £47,851. To this had to be added £490 as the increased cost of working owing to reduction of output, and this gave a total of £48,341. During the time the excess works were gradually coming into use, they would have to be maintained; but he did not claim anything in respect of the fact that the Corporation would have to spend money upon the works before they really wanted them.

Cross-examined by Mr. HONORATUS LLOYD, witness said that financially the Corporation were not quite at the "end of their tether."

Mr. HONORATUS LLOYD: Do you remember, when the Margam Bill was before Parliament, Mr. Wedderburn, who represented the Aberavon Corporation, telling the Committee that they recognized that, if they were to have a fresh concession, it must be upon the terms that Parliament had prescribed for the restriction of profit, and that he should not ask for anything else?

Witness: I do not remember that.

Mr. HONORATUS LLOYD read extracts from the proceedings, in which references were made to the Salford, Glasgow, and Oldham cases, and concluded: Therefore you see that during the hearing of the Margam Bill Mr. Wedderburn said that, though it had nothing to do in his view with the Margam Bill, when his Bill came on he should probably not resist the proposal to restrict the profits in some form or other. Do you accept that as a fair paraphrase or not?

Witness: He said that he would not resist.

He said he considered that there should be a clear order as to the way in which surplus profits should be disposed of?—That is to say, that Margam ought to have some share of the surplus profit.

Cross-examination resumed: What he was valuing was the future of the Aberavon undertaking based on the past results. He had not taken into consideration the suggestion put forward—that their Counsel had frankly invited Parliament to restrict the profit.

Mr. HONORATUS LLOYD: Did you tell me yourself that the Corporation were practically at the end of their financial tether?

Witness: Yes.

Do you suggest that they would have been permitted to go on supplying customers that they had, and not providing for future demands? Why did they come to Parliament? Would they not have been bound to take on new consumers under their existing Act, and could they have done it?—Only to a comparatively small extent. They could not have gone on indefinitely.

Do you not think, having regard to these circumstances, that their future must have been one of restricted profits?—I could not agree with that.

What ground have you for taking unrestricted profit, after what we know took place in Parliament?—Whatever was the profit they were making, they were at least charging a price for gas that compared favourably with all other undertakings in the district.

Cross-examination continued: He had made no valuation from the point of view of restricted profits. The basis of his value was the maintainable profit, unrestricted by any parliamentary action. He had made a structural valuation of the undertaking. He valued the mains as a whole, and then he valued the distributing plant in Margam separately. The latter figure was £8391. That was for mains, services, meters, cookers, &c. These were the physical assets the Council would get for their money. The total amount of loans outstanding at March 31, 1911, was roughly £30,000.

Mr. HONORATUS LLOYD: So that if you get what you ask, you would have the Aberavon undertaking with the whole of the capital debt paid off, and have nearly £20,000 to go on with. A jolly good deal!

Mr. HARRY JONES: This 1·44d. per 1000 cubic feet you put on for repairs and maintenance is not merely a detailed valuation of what would be required upon meters, fittings, and stoves, but a figure to bring up the total to your idea of 7d.?

Witness: Yes.

I suppose you are aware of the figures of some of the companies who go in largely for coin-meters—what it costs to repair them?—Yes.

Mr. *Henry Woodall*, examined by Mr. BALFOUR BROWNE, said he was acquainted with the proceedings in Parliament which led to the Margam Council being granted powers to purchase; and he had visited both the old and new gas-works in Aberavon. The undertaking had not until recent years been self-supporting. In 1903, however, it turned the corner. During the earlier years the ratepayers of Aberavon were really paying to some extent for the supply of gas to the Margam consumers. That was to say, there was a loss which Aberavon alone had to make good. Now the undertaking was a very valuable asset. Its growth had been extremely rapid, especially during the last two or three years; and in this period the total increase had been somewhat greater in Margam than in Aberavon. During this time the price of gas in Margam had been the same as in Aberavon. The public lighting was on a different basis; but it really came to the same thing. In many cases, of course, differential charges obtained. He had prepared a valuation of the undertaking to be acquired by the Council. The first thing to do was to arrive at the maintainable profit for the year ending March 31 last. This date was taken only because it was the last complete year for which the accountants could get out the figures. Then he took the prospective profits up to the period when the capital that was available would be exhausted. Before doing this, he had to decide whether the expenses in the year of account were all that were necessary to arrive at the maintainable profit; and as he had had to adjust the accounts in this way by taking off an expenditure which had not actually been incurred, he thought he was also entitled to look into the future. For this, he had actually three-quarters of the year to go upon. He took the working profit figure of 18·71d., but added to the charge for maintenance and renewals 0·44d., making the total allowance under this head 6d. per 1000 cubic feet, which he believed was sufficient to repair, maintain, and renew. The maintainable profit arrived at (£1541) he multiplied by 26⅝ years' purchase, on the 3¾ per cent. table. This gave £41,093. The prospective profit he dealt with in the same way, first having estimated the amount of gas to be sold—that was, 8,000,000 cubic feet, multiplied by 17·73d. per 1000 feet, multiplied by 26⅝ years, giving £15,760. The only difference between himself and Mr. Newbigging was the 1d. for repairs and maintenance.

Second Day.

Mr. *Woodall*, recalled, and further examined, said that as the plant which produced gas was not being transferred, he had given Margam credit for the portion which would be sufficient to make the gas which was earning the revenue—the amount allowed in this way being £10,150. As had been explained, they had reckoned that in seven years Aberavon would need all the surplus works that would be left on

its hands; and the deferred value of these works was calculated at three-and-a-half years. In one particular quarter the growth of consumption in Margam had been particularly rapid; this being due to a big consumer coming on. The purchase being a compulsory one, he had added 10 per cent. to his valuation. Then there was the joint table with Mr. Newbigging, showing £490 for the additional cost of working during the reduction of output. He saw no reason why the profit of the undertaking should not be maintained. The price of gas, as compared with that in surrounding counties, was moderate.

Cross-examined by Mr. HONORATUS LLOYD: In making his valuation, he had left out of consideration altogether any possible interference by Parliament with the maintainable income. He took the facts as they existed at the present time. He was familiar with the Oldham, Glasgow, and Salford cases; but he did not think it was for him to consider whether there was any risk of such a clause being applied in this instance. He did not say there was no risk, but merely that he had not considered it. He would admit that there was a risk, but would not say that it was serious. Any risk there might be would not make any difference to his valuation. He had simply taken the purchase clause and worked out his figures upon that.

Mr. HONORATUS LLOYD: In making your valuation, have you assumed that if a statutory undertaking has come to the end of its capital it can go on for all time supplying the customers it then has, and that it has no duty to provide for others?

Witness: My valuation is based upon the assumption that we can go on supplying for a short period. I certainly think until March of this year.

Cross-examination resumed: By that time Aberavon, if they had gone on as before, would have required fresh capital. His 6d. per 1000 cubic feet for repairs, maintenance, and renewals was intended to cover everything—works, mains, meters, and stoves. His valuation was just short of £52,000, which would start Margam with a capital of £1800 per million cubic feet, without any manufacturing works – that was, calculated on the 28 million cubic feet.

Re-examined by Mr. BALFOUR BROWNE: Aberavon had nothing to do with what would be the effect of the transaction to the purchaser. What they were concerned with was what was to be paid to the seller. His valuation was based upon the Margam Act; and it followed the same lines as in the Kirkby-in-Ashfield arbitration, which was a very similar case to this. Of course, anything might be done by Parliament.

Mr. HARRY JONES: About the 6d. for wear and tear, you and I are familiar with gas undertakings in the South of England and round London. Do you know any of them who get off with 6d.?

Witness: I do not think I do; but I do not think it fair to make a comparison with the London and Suburban companies. You ought to take corporations.

With the London Companies, would it amount to nearer 9d. than 6d.?—I should say it would amount to more than that; but these are figures taken from "Field's Analysis," and I think the right ones to take are those of corporations. You will find with the whole of the corporations mentioned in Field the amount spent on repairs and maintenance of works, mains, meters, and stoves does not amount to 6d. The average is only 5·24d. for the last year. If you take the companies outside London, you only get just about 6d. The average of the provincial companies is 6·17d.

They are all large undertakings quoted in Field?—I should have said that argument was not against us from that point of view.

Smaller companies, on the face of it, must find more difficulty in carrying out repairs than large undertakings who have a technical staff and their own skilled people on the spot. When the Margam undertaking starts, it will have another £11,546 to put on to the £52,000, as it will have to build its works. This will mean about £63,500, or £2300 per million cubic feet will it not? If so, would it take 2s. 3d. on every 1000 cubic feet of gas to pay 5 per cent. for sinking fund and interest?—I have not worked it out.

Mr. CORBET WOODALL: Your valuation is £1800 per million, and the estimated cost of erecting new works £400. This would mean £2200. Is that without precedent in your experience as the price to be paid for an undertaking?

Witness: It has been paid, not in a case of severance, but in the case of a corporation purchasing a company's whole undertaking.

Do you draw any distinction between a severance and the transfer of a whole undertaking?—I do not see any difference.

So £2200 would be the total sum that Margam would have to spend in order to get a fully established and equipped works? Has that been exceeded in valuations in the past, and in those cases have the purchasers failed to make a profit?—I think there is only one case in the history of transfers where there was a failure to make a profit.

As to the 6d. mentioned for repairs, maintenance, and renewals, does not the amount depend largely upon the character of the works? If you have a works fully equipped with machinery, will not the wear and tear be larger than where there is no machinery?—Yes. In this case there is no machinery. It is ordinary hand-charging.

Mr. *A. J. Bond*, in answer to Mr. WEDDERBURN, said he had been Manager of the Aberavon Gas-Works for the past ten years. The holder on the old site was not just now in use, but it was in good condition. Since the passing of the Margam Act the Aberavon Corporation had done no active canvassing, but they had taken on the consumers in both districts who had applied to them, and had supplied them without difficulty. The consumer who had been referred to as taking about 2 million feet a year was charged 3s. 6d. less 20 per cent., or 2s. 10d. per 1000 cubic feet net. When the severance took place, Aberavon would be left with excess works for a time; and Mr. Woodall and Mr. Newbigging thought it would be seven years before these works were fully utilized. His own view, however, was that the growth of Aberavon would not be so rapid as these gentlemen anticipated. The increase in population during the last decade had only been 4 per cent. per annum; and he had no reason to expect a greater rate of growth in the future.

Cross-examined by Mr. VESEY KNOX, witness said that in Aberavon they had now on their books 42 applications for prepayment meters from people who were not yet connected. He had to be careful as to putting out slot meters at the present time, so as not to over-tax the works for next winter. During this winter they had one reserve bed of seven retorts. There were 56 retorts altogether; and they worked seven beds. It was not the fact that when Mr. Frank Jones visited the works in December the bed out of use was practically in a condition in which it was not safe to work it. It was in some disrepair. The maximum daily make last winter was 260,000 cubic feet. They had been working fairly well up to their carbonizing capacity. They could not go on for any very considerable length of time supplying the two districts, without further expenditure of capital. He had to be careful as to the number of new consumers he put on. He had always connected ordinary consumers who applied; but he did not think the obligations were equal in respect to the two classes. It would not be his policy to take as much as he could from gas profits for the rates. He would build up a depreciation or reserve fund; and then apply any balance to reducing the price of gas.

Re-examined by Mr. WEDDERBURN: The sales of gas last year were well within their existing capacity. They would have to go on supplying Margam until they got works of their own; but how long this would be, he could not tell. In the matter of retorts, they had a good margin in hand.

Mr. HARRY JONES: If you have this margin, why do you refuse to put on the forty small slot consumers?

Witness: I have not refused them. They will be put on—a small number; but I wanted to be careful not to put on too many.

Mr. *Henry Woodall*, re-called, said it was correct that, taking his valuation and the cost of the works, the total would be £63,409, and that it would require 2s. 3d. per 1000 cubic feet to pay 5 per cent. interest and sinking fund on this. As to how much would be added for working expenses, on the basis of Mr. Cash's table, if they took it that the cost was to be the same in Margam as in Aberavon, the total cost of gas, in order to pay interest and sinking fund, would have to be about 4s. 1d.

This closed the Corporation's case.

THE CASE FOR MARGAM.

Mr. HONORATUS LLOYD remarked that, on behalf of Margam, he wished to put forward some observations at this point, because there was a matter of principle to be decided. He need hardly remind the tribunal that what they were considering here was, under the Act, the amount to be paid by the District Council in respect of the portion of the undertaking of the Aberavon Corporation which they were to acquire; and when he said this, of course, he included such compensation for severance as might properly be claimed. The principle arose when they had to consider how this portion of the undertaking was to be valued. What was to be paid here was, in the first instance, the value of the maintainable profit. In the word "maintainable," to his mind, was the whole gist of the thing. His learned friend seemed to think that because, given certain conditions, they could continue to carry on the business and produce a stated financial result, it was therefore necessarily maintainable. But they had to carry out their duties under parliamentary conditions; and what he (Mr. Lloyd) said was that, having regard to the trend of recent legislation, it was perfectly clear that Parliament did not intend to allow a municipal trader to carry on business in such a way as to milk the consumers in outside districts in order to afford food for the ratepayers in the supplying district. The principle at stake here was whether the tribunal were going to accept as maintainable an income the maintainability of which he ventured to suggest Parliament had most clearly set its face against. The gist of the Corporation's case was this profit, which had been sufficient to wipe out and over-balance any deficit experienced years ago; and if the tribunal were going to say that this would go on in perpetuity, then they would have to capitalize the income, broadly speaking, on some such figure as the other side suggested. But he said that if they looked at recent decisions of Parliament, there was no gainsaying that the policy had been to restrict the amount of profit that should be taken by a local authority trading in gas. It was quite true that, so far as the Glasgow case was concerned, there was some distinction; but they must bear in mind that what happened was that the whole net profit was prohibited. In that case, in the House of Commons, Parliament expressed itself very strongly. Though the Glasgow Corporation said: "Parliament itself has given us the right to apply our net gas profits to the 'Common Good,' and we have been very moderate, and nobody suggests that we have been hungry, and we claim the privilege of applying to the 'Common Good' the profit that we think right"—Parliament replied: "You shall not have a net profit at all." In the House of Lords, a number of ratepayers of Glasgow said in a petition that it was unfair for them to be deprived, for no reason, of a right and privilege that had been granted; but the House of Lords replied: "We shall take away the right the Corporation have of applying profits to the 'Common Good.'" He admitted that in Scotland the ordinary rule was that a municipal trading council should not make a profit; and Glasgow occupied an exceptional position. But look what the decision meant. It meant that Glasgow was deprived of an exceptional privilege in order to bring it into line with what Parliament thought was the right thing for the whole of Scotland—namely, no profit. It was a point strongly in his favour; for it showed that there was no justification for Glasgow applying profit to the rates, because it was a universal proposition in Scotland that it should not be allowed. During his own experience, it had been the practice, whether at the hands of other members of the Bar or at his own, to explain to Committees that one of the advantages of transferring an undertaking from a company to a local authority was that the local authority were generally in a position to borrow money on better terms, and that they had no shareholders to pay. What happened was that, when the local authority had got the undertaking, if they supplied consumers not only in their own area but outside, they would, if they could, extract such a price for gas as would give them a handsome profit from outside as well as inside; and the balance of profits went to reduce the rates of the purchasing authority. They treated their ratepayers as shareholders, and distributed the surplus profits among them. Now Parliament had at length seen this, and had been seeing it for some time; and it had taken this line. "If it is a candid reason that your local authorities put before us, that you can do things more economically and more satisfactorily as gas purveyors, do it, but do it for the benefit of the consumers. Supply gas on reason-

able terms. Do not do it for the relief of the rates of those who do or do not use gas." Therefore they had in the cases of Glasgow, Oldham, and Salford, either in Acts or suggested clauses, provisions to prohibit or restrict profits. He maintained that, in valuing this portion of the Aberavon undertaking, the tribunal were bound to consider what would have been the future of the concern had the Margam Bill not been passed. Though for many years Aberavon was asleep, there came a period when they began to supply gas on more or less modern principles. They reduced the price, started the prepayment system, and conducted the concern on more up-to-date lines; and they had now come within an ace of the end of their tether. They were working nearly up to their full capacity, if not quite; and the time had come when they must have gone to Parliament for a fresh concession, with the terms and conditions liable to review. Indeed, last year the Corporation did go to Parliament for further capital to enable them to carry on their gas undertaking. Granting that the Corporation were compelled to go to Parliament, the tribunal had to consider what was the future of the undertaking, if they had had to supply Aberavon and Margam. He suggested that they could only come to the conclusion that there was the gravest possible risk that Parliament would apply to them a restriction such as had been imposed upon others. When the Corporation were in Parliament, and the Committee had before them the alternatives of whether Margam should be separated or the Corporation should continue to supply both districts, Counsel representing Aberavon said: "Do not let Margam go. Leave us to supply ourselves and Margam; and in order to induce you to take this course, we shall not resist a clause restricting our profits." This showed that those who represented Aberavon were then of the same mind as he (Mr. Lloyd) was now—that it was not likely that Parliament would allow them to go on and work out their future unless they made an offer to restrict their profits. Mr. Wedderburn had said: "Do not give us the Glasgow terms, but some such clause as Oldham, which allows 1½ per cent." He was putting forward the best he could hope for. It was a matter of surprise that, after Counsel for the Corporation had taken this line before Parliament, Mr. Balfour Browne should have opened his case in the arbitration without mentioning one word of what had transpired.

Mr. WEDDERBURN: I suggested some such clause as Oldham. I never assented to a figure of 1½ per cent. If the matter had gone on, and the Committee had said: "We are going to put some such clause as Oldham on you," then I should have argued that we should have more than 1½ per cent.

Mr. HONORATUS LLOYD (continuing) said his proposition was that this was a matter of principle. It was agreed that the thing they had to look at was the future; and he maintained that Parliament must have put some restrictions on the profits. When the Corporation were in Parliament, those representing them accepted this position; and they offered, as a condition of being allowed to continue to supply gas to Margam, to submit to restriction. But now they turned round and said the Aberavon Bill was not passed, and they were in arbitration under the Margam Act. This was a childish reply, because it was obvious that what they were seeking to value was the future of the undertaking, and the future they said they would look forward to was the future under their Act, if they obtained it. Therefore the only future they could have looked forward to if the Margam Bill had not passed was one of restricted profits. Mr. Woodall had told them that, having regard to what took place in the House, there was a risk that restriction might be put upon the profits; but he would not go so far as to call it a serious risk.

The UMPIRE: A slight risk, I think he said.

Mr. HONORATUS LLOYD (continuing) said that, assuming for a moment that every farthing of their net profit from a financial point of view was maintainable, Mr. Henry Woodall had told him there was a risk that Parliament would not permit it. But he had been instructed to shut his eyes to it, and asked for 26⅔ years' purchase, which was precisely the same figure that he would have asked if there had been no element of risk whatever. This could not be right in principle. He submitted that the only question for consideration was: What amount of profit (if any) would Parliament have permitted the Corporation to earn and divide in one form or another under their new concession? He had gone somewhat at length into this matter, because he regarded it as very important, not only in this particular arbitration, but to the public and the gas industry. If they were once going to establish, by adopting the principle put before them, that local authorities, when they were compelled to part with the whole or a portion of their undertaking, could get at the hands of this tribunal or a similar one profits capitalized in perpetuity which Parliament had said for the future they should not earn, and which they themselves had offered to give up, they would inflict upon the gas industry a very grave hardship. There were three conceivable methods by which this undertaking might be valued without injustice—upon the Glasgow, Salford, or Oldham lines. Whichever was adopted, it would be necessary to see that they were allowed sufficient to cover capital charges; so the first item he would put forward as payable by the Council would be the present value of the instalments of principal and interest upon the outstanding debt. This would be equivalent to allowing them sufficient profit to discharge the whole of these capital charges. Next, it would be necessary to find the share that was fairly applicable to Margam. They knew the percentages of Margam and Aberavon were roughly 45 and 55; and therefore they took as due to Margam 45 per cent. of the amount. But from this, of course, there must be a deduction on the lines given by witnesses on the other side, because, though they would be paying the deferred value of the whole of the capital charges upon their portion, they would in return for this theoretically get their part of the works. But, in fact, though they would get the distributing plant in the district, they would obtain no portion of the actual works where the gas was made; and therefore they had to find the proportion and value of the works which should be deducted. They had taken the value of the new works, and had added the sum which they had been told had been spent upon retorts in 1911-12; and having arrived at the cost, they deducted 45 per cent. for their proportion. But from this they deducted, again, a sum which had been repaid in respect of loans. The net deduction was made from the deferred value of the capital charges—giving a figure of something under £8000. The next item which would be common to all three methods was the damage that would be caused by the severance, in respect of excess works. Here there was not very much between the parties—only £140. Part of this difference was due to the fact that, whereas the Corporation had taken the excess works as being thrown on their hands at once, the Council had assumed that, inasmuch as powers had been taken to supply Margam in bulk during the transition period, the excess works would not be upon their hands at any rate for the first year. Therefore they deferred their excess for twelve months; and they also took it at six years. Then there was the increased cost of working owing to reduced output. Here, also, the difference was small—£490 for the Corporation, and £288 for the Council. These items would satisfy the Glasgow decision—that was, the Corporation would have been given sufficient profit to discharge the capital charges in so far as the capital related to the Margam portion of the works, with a deduction in respect of the works which Aberavon kept and Margam did not get, and compensation for the injurious effect to these works by the severance. This was what he was going to ask the tribunal to give. Supposing, however, it was considered that, under all the circumstances, the right principle was that there must be a restriction of profit, but that he was too drastic in suggesting that there was a real risk of the Glasgow clause being applied, then he would fall back on Salford. Everything he had said up to now would be equally applicable to Salford; but there would also be the question of allowing 1 per cent. profit on the capital outstanding. Again, if the conclusion was arrived at that Salford was too drastic, and that Oldham, as suggested by Mr. Wedderburn as giving 1½ per cent., was a fair thing, then they would add not 1 per cent. on the capital for the time being, but 1½ per cent. he presumed on the capital for all time. In the Oldham case, he believed, the amount was not arrived at as a percentage on capital at all, but was an annual sum which, for some reason, was fixed between the parties.

EVIDENCE FOR THE COUNCIL.

Mr. *E. Herbert Stevenson*, in answer to Mr. VESEY KNOX, said he had visited the district several times; and in 1888 his firm reported upon it. He again acted for the Aberavon Corporation when they obtained their last Provisional Order in 1896. In 1888, very little gas was sold in Margam; and in 1896 not a large quantity. In the last ten years the business had increased from 31 per cent. to (if the totals given by the witnesses on the other side were correct) 51 per cent. of the whole output. If, therefore, a loss was made in an earlier period, it must have been from the supply of Aberavon. As to the works, there were eight settings of seven retorts—56 in all. He had heard Mr. Bond's evidence, and calculated that if the retorts were in good condition they ought, without any alteration, to be able to make 300,000 cubic feet of gas per day, allowing one setting as a stand-by. This was after they had spent the £400 odd in the course of 1911. The works generally were fully up to this capacity, and in many portions beyond it, with the exception of the scrubber, which was short. The old holder he did not think worth considering—it was in such a bad condition. The works were really just about up to what they had to do to-day. They were thoroughly good works, well designed and built. He had made a structural valuation, and it agreed so nearly with Mr. Newbigging's that he accepted his figure. He had also made a structural valuation of the mains in Margam; and here, again, he accepted Mr. Newbigging's figure. He was convinced that if the Margam Council had simply opposed the Corporation Order on the question of the limitation of profit, the limitation would have been granted. He had taken into account, in forming his judgment of the future of the concern. what was said by Mr. Wedderburn and by the Borough Accountant as a witness in Parliament; and on this basis he came to the conclusion that the future would be limited in the same way as Glasgow had been limited. He had made a joint valuation with Mr. Frank Jones on this basis. In working out the deferred value of the instalments and interest for the repayment of loans outstanding after March 31, 1912, he had taken the loans on the 3½ per cent. basis. The amount was £29,948. He had taken, on the figures of 1911, the proportion of this relating to Margam at 45 per cent., or £13,477. This was for a proportion of the whole undertaking—works and distributing plant. But in order to ascertain just how much related to the part of the undertaking which was transferred—the distributing plant—he had to take at the actual cost the proportion of the works (£9255), less the part of the loan which had been repaid (£3674). Thus he deducted £5581; so that the value of the mains, &c., was £7896, which was, he believed, £500 less than Mr. Newbigging said they cost as new. They were of varying ages; and, of course, the value of them to-day was not that. To the £7896 he added for interest and instalments for loans outstanding on works lying idle £1257, and for increased charges per 1000 cubic feet of gas made £288—making his total £9441. He had estimated as accurately as he could what were the annual instalments which the Corporation had to meet; and for the next six years the annual figure would be £1252. To this he applied the 45 per cent. proportion, making (say) £564. In the first of these six years he assumed Aberavon was going to supply Margam in bulk; and therefore there would be no loss on the works for capital charges. The other five years he had taken at diminishing amounts, giving a total loss for works lying idle of £1257. The difference between his figures and those of the other side as regarded the last items was mainly due to the one year in which gas would be supplied in bulk, and to the fact that Mr. Woodall and Mr. Newbigging began with a much higher figure (nearing 29 million feet), whereas his own calculations were all based on the figures for 1910-11. If the Salford basis was agreed to by the tribunal, something would have to be added to his valuation.

Cross-examined by Mr. BALFOUR BROWNE: He had at one time made a structural valuation; but he did not think it was the right system to take. It came to slightly less than this one. The present one was a valuation of what he considered the Corporation could receive in future—he thought that it was the maintainable revenue which the undertaking could receive. He had never made a valuation on this basis before. There had been no case of severance in arbitration since Parliament had taken the strong stand it had now done. He had given evidence in the Kirkby-in-Ashfield arbitration on the lines that Aberavon were putting forward now; but that was some years ago.

He thought Kirkby had not to come to Parliament to get loans—they had power to get loans from the Local Government Board.

Re-examined by Mr. HONORATUS LLOYD, witness said he had set to work to ascertain what would be the amount of gross profit that would pay off the instalments of capital charges year by year; and this was what he considered to be the maintainable revenue.

Mr. CORBET WOODALL: You say this is the first time you have adopted this method of valuation?

Witness: It is the first time that a valuation for the purchase of a local authority's undertaking has taken place where I consider that the profits would be limited. I am valuing what I think the local authority would be able to take out of the concern in order to pay off their borrowed money. It is quite different from what has taken place in the past, because up to the present no arbitration has taken place since the Glasgow, Salford, and Oldham clauses have been thought of.

Glasgow is Scotch, and for that reason might properly be left out?—Well, to balance that, you might take Stoke-on-Trent, where no profit is allowed now. Certain of the districts had gas undertakings, and others had not.

The other case which you say justifies this alteration of method is Salford. This is not really a precedent, because nothing was done by Parliament?—If you want an exact precedent, there is Glastonbury and Street, where the same provisions were made as were put in the Salford Bill. That was an Act passed; and it was because Street opposed upon this one point.

In the case of Oldham, I am told the Bill limiting the profits was passed in 1886. That has been on the Statutes for all these years; and between that time and now you have had to do with more than one valuation of separated areas?—I may say at once I never had any knowledge of the limitation of profits in Oldham until the Act of 1900 was passed. Then I know of the discussion about profits.

Mr. *Frank Jones*, in answer to Mr. VESEY KNOX, said he had advised the Margam Council throughout the proceedings which led up to the arbitration. He knew the district well; and as to the works, they had this winter been utilized up to their full capacity, as far as the retorts and most of the plant were concerned. He was there just before Christmas; and all the retorts were hard at work, with the exception of one bed of seven, which was in a more or less dilapidated condition. Two beds which were at work had the fronts bulging out. He agreed that there was a large field for extension in Aberavon; and five or six years would easily use up the surplus works. The valuation which had been put in was prepared by Mr. Stevenson and himself jointly. Under this valuation, as far as paying off loans, &c., was concerned, the Corporation would be in just as good a position as before. In his opinion, the income suggested by Mr. Newbigging and Mr. Woodall could not have been maintained. They could not have gone on taking the large amount of profit out of Margam. With the figure of £2300 per million cubic feet, Margam could not sell gas at the present price and meet interest and sinking fund charges. The figure of 6d. taken by Mr. Woodall for repairs, &c., was quite insufficient.

Cross-examined by Mr. BALFOUR BROWNE: He had given nothing for prospective value. The works, as works, were, he admitted, good; and with proper repairs and renewals they could go on supplying the same amount of gas as now. To meet further demands, additional capital expenditure would be necessary.

Re-examined by Mr. HONORATUS LLOYD: He went down to a Council meeting at Margam; and they were determined that the "maintainable" income should not be maintained. They would not go on paying such a price for gas as would benefit the ratepayers of Aberavon in the way they had been benefiting.

Third Day.

The sitting on the third day of the arbitration was a short one; the proceedings consisting only of the

FINAL SPEECHES OF COUNSEL.

Mr. HONORATUS LLOYD, on behalf of the Margam Council, said he regarded the matter of principle which he had raised as being one of vast importance. The question was what was the profit maintainable, as he submitted, not only from a financial, but also from a parliamentary and commercial point of view. The case he had put forward had been that, whatever might be the figures the Corporation might have financially shown that they could earn, the tribunal had to take into consideration some sort of limit. Take for a moment the purchase of an undertaking which had a maximum amount it could divide. In such a case frequently the accounts showed the concern was earning, in fact, considerably more than the sum necessary to pay the maximum dividend. Supposing the maximum dividend amounted to £1000, they might find that in the account year £1500 was earned; and so far as one could say financially the undertaking might be quite capable of producing the £1500 in perpetuity. But what did they do in such a case? They multiplied, of course, the maximum dividend, which was the limit of the amount that could be divided. So here, the moment they arrived at the parliamentary, commercial, or other limit, this was the amount that had to be multiplied—provided they were satisfied the accounts showed this limit could be earned. His learned friend had put in figures showing the gas consumption in Margam, and what was called prospective consumption, and the profit thereon; the prospective consumption being arrived at by taking the returns for three-quarters of the current year, and making an estimate as to the fourth. A profit in Margam of £1541 was brought out, to start with. To this was added the prospective 8 million feet; and on this a profit of £591 was taken. It was also said that the consumption in Aberavon would be 28 million feet, and that the profit was uniform. Therefore, if he took the Corporation's own figures in Aberavon, and applied the adjusted figure of 17·73d. per 1000 cubic feet profit, he got a profit in Aberavon of £2083—say, a total of £4215 gross profit, on a capital outstanding of some £29,000 odd. In other words, they claimed in the year ending March 31, 1912, to take 14 per cent. out of the concern as gross profit. It had been argued that a local authority under these conditions should act as a company. Could they conceive a company being allowed to take 14 per cent. out of such an undertaking? With the 14 per cent., they were in a happy position. They had to meet temporarily their loan charges, which came to 8 per cent. on the outstanding capital, and left them with 6 per cent. net profit. He said "temporarily," because the loan charges would gradually disappear; and when they had been wiped out, if the Corporation went on in the same way, they would be taking 14 per cent. net profit out of the undertaking. They claimed this in perpetuity; but Parliament would not have permitted it. But even without any restriction, could they conceive anyone being so unreasonable and so shortsighted as to go on endeavouring to draw such exorbitant profits out of a gas undertaking? Even assuming that the loan charges would go on in perpetuity, and taking this 8 per cent. as a fixed initial figure, if they decided that the Corporation should, as reasonable beings, be content with (say) 1½ per cent. net profit beyond this, the total of 9½ per cent. would compare with the 14 per cent. which he had worked out on the figures of actual profit claimed. So that if, without restriction, they acted as reasonable beings, and came down to drawing 9½ per cent., they would receive two-thirds of the profit they were getting now. This would bring the Margam profit of £2000 down to about £1300. Taking the £1300 on these lines, the next question was the multiplier, and on the 5 per cent. table they would get a figure of about £26,000. Deducting £10,000 for the works necessary to earn this, which would not be transferred to the Council, there remained £16,000. He passed over the allowance for compulsory purchase; and other items came to £400 or £500. Under these circumstances, taking the figures on the Corporation's own basis (except the multiple), the total would be £16,500—reckoned on a commercial footing. He had left out here any consideration of parliamentary restriction—simply urging that public opinion on both sides (the suppliers and the consumers) would not permit 14 per cent. to be taken out of the concern in perpetuity. In addition, of course, there was the question of restriction, with which he had already dealt. This was a point he strongly insisted upon; and if his learned friend put it forward, as a matter of law, that the tribunal were not entitled to consider what the future of this undertaking might have been—a future with a clear restriction—he (Mr. Lloyd) would ask the Umpire to state his award in the form of a special case, asking the Court whether the tribunal ought, or ought not, to give consideration to the points raised. He maintained that, as a matter of law, they were bound to take the question into consideration—though, of course, they might say it was worth nothing. Having referred again to Glasgow and Salford, he said Oldham was on a different basis, because in 1886, he understood, an Act was passed limiting the profits at Oldham to 6 per cent. This really rather strengthened his position; for it showed that, even at that time, Parliament was recognizing that there should be a limit put upon what local authorities could draw out of undertakings. In 1909, Oldham had had to go through the mill again. Then, when they were in Parliament, they agreed that there should be a fixed sum of £7500 a year taken.

The UMPIRE: Has there been any evidence of what that sum amounted to?

Mr. HONORATUS LLOYD: I think you will find it works out at about 1½ per cent. on the original capital, and 2·395 per cent. on the capital then outstanding, in the account year. It was not arrived at as a calculation; it was an agreed figure. It showed that, though Oldham had been in Parliament and been restricted to 6 per cent. in 1886, when they came again in 1909 the 6 per cent. went, and was brought down considerably.

Mr. CORBET WOODALL: The 6 per cent. included interest on capital; but the £7500, I think, is a surplus.

Mr. HONORATUS LLOYD (continuing) said the Glastonbury and Street case resulted in a limitation to 1 per cent. net profit after a fight. Whether they took the present case from the point of view of the risk of parliamentary restriction, or from the point of view of restriction imposed upon themselves from commercial considerations, the result was practically the same—though he put it, as a matter of law, that, as it was the future of the Corporation supplying Margam and Aberavon together that had to be considered, the tribunal must take into account whether they were running serious risk of being restricted by Parliament. So far as his side had been able to ascertain, there had been only three cases in which arbitrations for severance had taken place during the last ten years; and the circumstances were different from those in the present one.

Mr. BALFOUR BROWNE, replying for the Corporation of Aberavon, said that, so far as he had seen, there never had been presented to such a tribunal as this a meaner case than the one now submitted. He thought it was a pity generally to try to interpret Acts of Parliament by what had been said by Counsel or witnesses when they were in the House; but it was worse to attempt to interpret one Act by what was said about another Bill that did not pass. There never was any idea that they were to part with profits to the extent of £1541 a year for nothing. He felt convinced that this was not in Mr. Vesey Knox's mind when he said "full compensation," and that it was not in Lord Lamington's mind when he passed the Bill. He would be surprised if "the man in the street" would for an instant have contemplated that they were to hand over works which by admission were worth a large sum for nothing. It was the future they had to look to, and not the past. The past, taking it to March 31, 1911, was only a guide to what they might make in the future; and the only restriction he knew of that must be considered was whether they could have made less or more in the future. If it was less, the 1911 figures had no bearing; if it was more, they must add to these figures. No one was in a position to say what Parliament would do. He remembered the transfer of the water undertaking to the Sheffield Corporation very many years ago, which came before Lord Derby. The Company had an increase of rental of 25 per cent. allowed, owing to the bursting of a great reservoir. The time of this had come to an end, and the Company went to Parliament to get it continued. The Corporation, however, came along with a Compulsory Purchase Bill, which Lord Derby passed; and he said he did it on general principles. In the course of subsequent discussion, Lord Derby explained that, though he had inadvertently used the words "general principles," it was on the merits of the particular case that he had decided it. Then on one occasion he called to mind that there were four Purchase Bills introduced; and two of them were passed, and two rejected. So what was "the trend of Parliament"? His learned friend said the Corporation were in receipt of

14 per cent. profit. What was Birmingham in receipt of? Parliament had not restricted them.

Mr. HONORATUS LLOYD: The question has not so far arisen with Birmingham.

Mr. BALFOUR BROWNE: It has not arisen here. If they do not buy, I can go on making any profit. Continuing, he said there was another case which his learned friend might have quoted. It was the Stalybridge and Dukinfield Bill. The authorities wanted to purchase a gas undertaking which supplied not only them but a place called Mossley. He (Mr. Balfour Browne) was appearing for Mossley, and said: "If I remain part of the Company's area, their statutory dividend is limited. If Stalybridge and Dukinfield buy, they have no limitation. It is not fair. Leave me in the same position I should have occupied if the Company had continued supplying." And Parliament did put in a clause. So far as he remembered, the next was the Oldham case; and he was in that too. There it was suggested that there should be a limitation. But these cases did not show the trend of parliamentary legislation. The only way they could get at the mind of Parliament in every case, was by a General Act. He ventured to say that the proposal made by his learned friend was absolutely novel. It had never been applied before; and yet if it was right that the trend of parliamentary legislation was in the direction of limitation, this trend was known in 1886. In fact, in the case of Stalybridge and Dukinfield before that, and in Glastonbury and Street in the year 1900. In the present case, the price was absolutely uniform all over the district. He was not going to argue this question as a matter of law; but he did ask the tribunal to pay no attention to it. What they had to deal with was the Act of Parliament under which Margam was purchasing. If the Umpire was going to consider the trend of parliamentary opinion, and state a special case, would he mind telling him what profit he was going to allow the Corporation.

The UMPIRE: You will know by-and-by.

Mr. BALFOUR BROWNE: Are you going to put me under the Salford clause or the Oldham clause—which was about 1½ per cent., but now amounts to 2·395, and must go up, because it is a rising percentage as the capital comes down? Some day it will be 14 per cent. He is asking you to legislate; and you have no right to do it. There were several gas cases in 1911 in which corporations asked for further powers. Rotherham were supplying an outside district. They came for £25,000 further capital. They got it with no restriction whatever.

Mr. HONORATUS LLOYD: Did anybody ask for it?

Mr. BALFOUR BROWNE: If it was the right thing, it ought to have been put in without being asked for. St. Helens—an outside district, further powers, with no restrictions. Warrington—an outside district, further capital powers, no restriction. In another, there is a totally different restriction from the one they want to put on us. Marple has an outside district—further capital, no limitation of profits; but at the end of ten years the charge is to be the same in the inside and outside districts. We are the same to-day. Continuing, he said that if it was a rule that profits were to be restricted, it ought to be put in all Bills, opposed or unopposed—it should become a Model Clause. The Chesterfield Water and Gas Board got an extension of their limits of gas supply to various places, with no limitation of profits. His learned friend said that in the case of a maximum dividend company they would multiply this, if they had earned the maximum dividend. He was not quite right, because even with a company that had a maximum dividend, if there were arrears of dividend these could be made up; and in Oldham they were allowed to make up deficiency. This made it perfectly certain the ratepayers were not going to suffer any loss. Where did the other side in their valuations allow anything for arrears? When a corporation went to Parliament and asked for some new concessions, Parliament had a right to say: "In that case, we think in future you should be partners—the inside and outside districts." The result of this claim on the Council's part would be to make the Corporation partners with them in the past; and they had never been partners. He thought that probably in future, though it had not been so in the past, Parliament would say that outside districts should be treated by a corporation no worse than by a company; and this would be only fair. But he could not say what Parliament would do. This undertaking must be valued upon what it was worth to the seller. It did not matter a bit what the purchaser could make out of it. And it was not disputed that, with their present powers, the Corporation's maintainable income was what they had put it at—apart from restriction. There were no restrictions in the Act. It did not matter what Counsel said in Parliament.

The UMPIRE: I am going upon what is proved to me here.

Mr. BALFOUR BROWNE: And what is proved? They have made a valuation based upon restrictions which have not been put upon us, and which I do not believe would have been put upon us. Continuing, he repeated that what the tribunal had to do was to find out the profit which the Corporation could maintain under their present conditions. They could maintain £1541 and £591. What limited them to this was the question of capital in hand. This was the only restriction that could be considered. A statutory company was bound by its Act. It had been held distinctly in the case of a railway company that was ordered by the Board of Trade to put up a bridge in place of a level crossing, that the fact that it had no money was a perfect answer. Suppose he went to Parliament, and they refused capital, how could he then supply new consumers?

Mr. HONORATUS LLOYD: The alternative is 40s. a day for each would-be consumer.

Mr. BALFOUR BROWNE: If I were bound to supply future consumers, I should claim for all. There is no such duty beyond your capital limit. They are asking you not to interpret section 6, but to legislate, and put a restriction upon me that I have not got—one that robs me of £2000 a year; and I say it is a mean case. It is an attempt to confiscate for their benefit that which, by their own acknowledgment, I earn to-day. Continuing, he said supposing they were a gas undertaking for which they put down £10,000, and expected returns which would bring in £10,000 a year, what was the value? Was it the £10,000 they had put down, or the £10,000 they were earning? Of course, it was the amount they were earning. The Council's valuation was not a valuation at all—it did not touch the works, it touched the loans; and this was not a valuation of the undertaking within the meaning of the Lands Clauses Act. Mr. Woodall and Mr. Newbigging had made valuations; and the only point really was as to the 6d. per 1000 cubic feet for repairs and renewals. He would not ask the tribunal to take the 6d., but Mr. Newbigging's more liberal figure. It was said that the profits were exorbitant; but was this the case? A large portion of the 14 per cent. was made by Aberavon out of themselves; and Margam could not object to this. But after taking off 8 per cent. for loans, which a company would do before declaring a dividend, it only gave 6 per cent. net. It had been suggested that the £50,000 claimed would make Aberavon rich and Margam poor. The tribunal had nothing to do with this. It was quite true that in Parliament Mr. Wedderburn had pointed out strongly that it would have this effect, and put a very heavy burden on Margam. But Margam said: "We do not care about the burden; we want to control our own gas-works." He asked the tribunal to say there was only one real valuation put before them (the one by his two witnesses); that they could not anticipate what Parliament might do; and that they had to consider the value of the undertaking with the maintainable profits, restricted only by the chances of rise or fall in the district or by the statutory limitations the Corporation were under to-day, and not by any statutory limitation they might be put under hereafter.

Mr. HONORATUS LLOYD said his learned friend had not raised the point on which he would have had to ask for a special case.

The UMPIRE said that, as he understood section 6 of the Act, subsection 1 was the basis on which the tribunal must make the valuation. They had to look to the maintainability of the profit. Mr. Lloyd asked them to have regard to the fact that Parliament had, in certain cases when authorities came before them, put on restrictions. It did not seem to be denied that they might regard the fact of what Parliament had done, so long as they regarded it in other cases as not so done; but their basis of decision was to be under sub-section 1.

This brought the hearing to an end.

PRESENTATION TO MR. GEORGE CLARRY.

Appreciation of Exhibitors at the Cardiff Gas Exhibition.

At the Royal Automobile Club, London, on the 12th inst., Mr. A. P. Main, of Messrs. R. & A. Main, Limited, presided at a dinner at which the guest of the evening was Mr. George Clarry, the Secretary and Manager of the Cardiff Gas Company. The dinner was attended by representatives of the various firms who had shown goods at the recent gas exhibition in Cardiff, and who had met to express in some tangible form their appreciation of Mr. Clarry's strenuous and successful management of the undertaking.

In proposing the toast of the evening, Mr. Main said it was seldom that business men met as they had done that evening, and it was rare also that they met to recognize such qualities as were seen in Mr. Clarry. Their guest had impressed them by his impartiality, his strenuous life, and his personal magnetism—qualities which, with great business capacity, had resulted in the splendid success attained by the exhibition, and in the immense appreciation of it shown by the people of Cardiff. Such success could not have been achieved had not Mr. Clarry been supported by the Directors of his Company and by a capable staff, who had worked enthusiastically and well.

On behalf of all the exhibitors, Mr. Main then presented Mr. Clarry with a handsome case of cutlery in a Chippendale cabinet, and a silver salver of beautiful design suitably inscribed.

Mr. Clarry, who was very warmly received, said he was greatly moved by the appreciation shown by those present of the work he had done in connection with the exhibition; and it was difficult for him to express his gratitude adequately. He had striven to do his duty in the fulfilment of any work which came to his hand. But for the cordial and unceasing support of his Directors and staff, it would have been impossible for him to have carried to success the many duties connected with the exhibition. He had had from his staff the most loyal and devoted help possible; and he was glad to have an opportunity of acknowledging this. He realized the immense possibilities of gas which were before the gas industry, and had endeavoured to make such a demonstration that the people of Cardiff should realize the great advances which had taken place in recent years in the production of gas and in its uses for lighting and heating. Without the valuable co-operation of the exhibitors, the exhibition could never have been the success it was; and he thanked them for all they had done.

LONDON COUNTY COUNCIL AND COTTAGE LIGHTING.

Gas on the Prepayment System.

At the meeting of the London County Council to-day, the Housing of the Working Classes Committee will submit the following report.

We have had under consideration the question of the arrangements to be made for the lighting of the cottages on the Old Oak Estate, Hammersmith, and have come to the conclusion that it will be most satisfactory to the tenants if gas be supplied on the automatic prepayment system. We have accordingly been in communication with the Brentford Gas Company and the Gaslight and Coke Company with a view to their supplying the necessary fittings, &c., during the erection of the cottages. The Companies have agreed to lay the mains during the construction of the roads, and to bear the cost of reinstatement of any finished roads, to provide all the necessary fittings, and to supply the gas at the same rate as is, or will be, charged to other consumers using prepayment meters. It is proposed that the agreements to be entered into to give effect to these arrangements shall remain in force for ten years from the date of commencement of supply, and shall be subject to determination by the Council or the Companies at the expiration of such period, or at any time thereafter, upon six months' notice. We recommend: "That agreements be entered into with the Brentford Gas Company and the Gaslight and Coke Company for the supply of gas on the automatic prepayment system on the Old Oak Estate, Hammersmith.

KINGTON WATER PURCHASE QUESTION.

The Kington Urban District Council met specially a few days ago to consider a letter from the Local Government Board. Last year, it seems, the Council agreed, after prolonged negotiations, to purchase the local water undertaking for £5500; and subsequently Mr. A. A. G. Malet held a local inquiry into an application by the Council for sanction to borrow £6000 to carry out the scheme. The letter that the Council had before them was on the subject of the inquiry, and stated that, "after careful consideration of the report made to them by the Inspector, the Board are not satisfied that they ought to sanction a loan for the purchase of the undertaking at the price proposed to be paid. Apart, however, from the question of price, there appears to be reason to doubt whether the purchase of the undertaking is the best solution of the difficulty which the Council experience; and, in all the circumstances, it would probably be well for the Council to take advice as to whether a more efficient water supply could not be obtained from another source at a cost not exceeding that which will be incurred if the Council purchase the Company's undertaking."

It was decided that the Clerk (Mr. W. T. Fewings) should write to the Board pointing out that the terms agreed to with the Company were highly favourable to the Council, and that the proposed purchase appears to be the only course to be taken. The letter concluded: "The Council consider that it would be disastrous to enter into competition with the Company, as the Company have mains covering practically the whole district; and the breaking-up of the ground to lay fresh mains would cause serious expense to the town. Practically all houses requiring water are supplied by the Company."

It was also determined that Mr. B. Philpin (one of the members, and Secretary of the Water Company) should send the Board a personal letter on the subject which he had drafted up. This drew attention to the fact that the Council have already thoroughly investigated the possibility of obtaining an efficient water supply from another source, having employed an expert to advise them thereon; but it was found to be impossible. The writer went on to say: "Assuming it to be feasible to obtain a water supply from another source, it would be disastrous from a financial point of view to establish an undertaking to compete with the Kington Water Company, as in all probability neither the Council nor the Company would make any profit. Since the year 1900, the Council have made overtures to the Company for the purchase of their undertaking. The Company in that year offered to sell for £9000, acting on the valuation of Mr. Wrestler, who then gave £9187 as the value. Since that date, the water-rents have increased by over £80 a year. Upon the renewal of the negotiations in 1908, the Company reduced the price to £7000. This reduction was made because the Directors recognized the small borrowing powers of the Council, and wished to facilitate the purchase in response to the wishes of the townspeople. These negotiations fell through, though the price asked was considered by the Directors to be no more than the value of the undertaking fixed by Mr. Yourdi, the Council's Engineer. His valuation was £6493, with stock-in-trade and expenses to be added, which he estimated at £450. Pressure was brought upon the Directors to reduce the price; and through the mediation of the Medical Officer of Health (who has throughout strongly advocated the purchase), the contract for the sale and purchase at the price of £5500 (including stock, and without the usual condition that the Council should pay the costs of the sale) was made. The terms of the sale and purchase were unanimously approved by the Council."

In the event of the Board further refusing to sanction the loan, the Council will probably send a deputation to London.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The minutes submitted to the meeting of the Glasgow Corporation on Thursday contained the report of a deputation which visited cities in England and on the Continent in regard to the system of street lighting by high-pressure gas. The deputation recommended, in the installation of high-pressure gas lighting already agreed upon to be proceeded with around St. Andrew's Halls and the Mitchell Library, and in the adjacent streets, that the compressor be situated between the St. Andrew's Halls and the Mitchell Library in a temporary building erected for the purpose, and should be gas driven—having a capacity equal to 5000 cubic feet (this compressor will require to be duplicated); that lamps of 4300-candle power and 2800-candle power be erected round the St. Andrew's Halls and the Mitchell Library; that lamps of 2800-candle power be erected in Granville Street, North Street, Bath Street, and in the connecting streets to Sauchiehall Street. In view of the numerous types of good lamps on the market, offers are recommended to be taken for a supply from each of the makers, to enable an exhaustive test to be made. In the meantime, it is proposed to erect an approved type of lamp in the streets surrounding the St. Andrew's Halls and the Mitchell Library, and the other streets adjacent thereto. The deputation state that there can be little doubt that the system of street lighting by high pressure gas is a great advance on the existing system of incandescent gas; and they were struck by the fact that in the cities visited the tendency is to extend the system throughout their areas. A scheme of lighting is to be prepared in reference to an additional number of streets in the city; and the recommendations have been approved of. [The full text of the report of the deputation appears on p. 225.]

The Falkirk Town Council had under further consideration, at a meeting which was held in private last Tuesday evening, the method of opposing the Linlithgow and Falkirk Lighting Order. Questions having been raised as to the area which would be fixed on in the event of the Order being opposed by an extension of the burgh, it was agreed that the area to be put before the ratepayers be as nearly as possible the gas and water areas—being practically Larbert, Stenhousemuir, Carron, and Carronshore. It was further agreed that a circular should be drawn up laying the matter before the ratepayers, and that this should be posted with a reply card, which will afterwards be called for by collectors. The Council's opposition to the Order is based on the contention that it would injuriously affect their gas undertakings in the villages round about the burgh.

At the same meeting, a minute of the Gas Committee set forth that they had again had under consideration the application by Mr. John Wilson, Assistant Gas Manager, for an increase of salary. It was agreed to continue the application, to be taken up with the other salaries in April. Mr. Muirhead moved the adoption of the minute, with the exception of the part of it relating to the retorts at the gas-works, which he proposed should be remitted back to the Committee. The Committee had again considered the matter of the charge for prepaid meters. In comparison with the charges made in other places, they found that the rate in Falkirk was low. In Falkirk, the extra charge for prepaid meters was 5d. per 1000 cubic feet, whereas in some places it was more than this. The motion was agreed to.

The Gas Committee of the Perth Town Council met on Thursday night and drew up a short leet of six out of 42 applications for the vacant post of Gas Manager. It is understood that this will be considered by the Town Council during the ensuing week.

At the recent meeting of the Moffat Town Council, Mr. Cavers, the Convener of the Lighting Committee, explained that the insufficient lighting of the previous week was due to the moon having failed to appear as was expected. Mr. Edgar pointed out that there had been an oversight on the part of the staff. Under the new lighting arrangement, he thought there was nothing to hinder their men watching when the dark nights came, and each taking his own district, as was the case before the automatic controllers were introduced. Provost Huskie considered that, apart from these occasional dark nights (when the moon was supposed to appear and the controllers were not in operation), the lamps were not alight for a sufficient time. After some discussion, it was agreed to ask the Lighting Committee to arrange for the staff to light up the various districts on special occasions.

In the course of a lecture in the Oddfellows' Hall, Edinburgh, on Friday night, Mr. Thomas Bishop, the Chief Sanitary Inspector of Leith, said that, if the price of gas were reduced to 1s. 9d. or 2s. per 1000 cubic feet, people's rooms could be heated and their food cooked as cheaply as with coal. There would be no smoke, soot, or dust, and the healthiness and the cleanliness of the city and burgh would be enormously enhanced. The great increase in the consumption of gas which such a policy would entail would soon repay the Gas Commissioners.

The inhabitants of the lighting district of Shotts are moving in the matter of getting what they will regard as a better quality of light at a lower rate. A deputation has been appointed to meet the Directors of the Gas Company on the subject. At a public meeting held on Wednesday, when this course was agreed to, one of the speakers said the ordinary meter charge was 4s. 2d. per 1000 cubic feet, and that the slot-meter rate was in some cases over 6s.

On Monday afternoon, an explosion of gas occurred in Hazelton Road, Bellshill, and the pavement for a distance of several feet was blown into the air. Fortunately no one was injured. The escaping gas ignited, and an immense fire was burning for some time.

Manchester Water Supply.—From a return presented at a recent meeting of the Water Committee of the Manchester Corporation, it appears that, despite the restrictions in the supply of water from August to November, last year the average daily consumption for the whole twelve months was upwards of 40 million gallons per day. In the fifties, it was between 9 and 10 million gallons daily, and it increased steadily from 12 millions in the sixties to upwards of 36 millions in the first decade of the present century. Last year the average daily supply was 40,337,492 gallons; in 1910, 41,679,085 gallons; in 1909 it was 41,127,509 gallons; and 40,041,451 gallons in 1908.

Lighting of Launceston Public Buildings.—At the meeting of the Launceston Town Council last week a discussion took place on the question of the lighting of the Guildhall, Town Hall, and Public Library. It had been decided at a previous meeting to invite a tender for installing the electric light, and the Town Clerk now explained that the Engineer of the Electric Light Company had asked for a specification. Dr. W. F. Thompson, the Chairman of the Launceston Gas Company, thought that as they were dealing with public money they should approach the question in an open-minded way, and also ask the Gas Company for an estimate. It was true that at present the Guildhall and Town Hall were lighted by gas; but it was in an antiquated way, with flat-flame burners. If the lighting was done with incandescent burners, they would have a light which could not be exceeded, and the cost would be quite under half the present amount He moved a resolution to the effect that the Corporation were willing, to receive suggestions for the better and more economical lighting of their public buildings; and it was carried.

New Mills District Council and the Supply of Gas to Disley.—The New Mills Urban District Council having applied for powers to extend their gas-supply area to include part of the township of Disley, a Local Government Board inquiry was held in the Town Hall at New Mills last Friday. It was explained that the cost of the extension would be about £4156; that the district to be supplied was not within the statutory limits of the Chapel and Whaley Bridge Gas Company; that the inhabitants of Disley had presented a petition to the local Council in favour of the township being supplied with gas; and that the New Mills Council desired to have included in the Provisional Order now applied for a clause authorizing them to charge for gas supplied by them in such part of the parish of Disley prices exceeding those being charged by them within their present limits. It was elicited that it was proposed by the New Mills Council to charge 3s. 3d. per 1000 cubic feet for gas in the added district, which is 9d. more than is paid by consumers in the existing area, and that in the event of future reductions in New Mills, Disley was to benefit to the same extent. The Disley Council, while not opposing the application for the Order, objected to the amount of the proposed differential rate. The Inspector said the objections raised by Disley would be considered.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Jan.* 20.

Sulphate of Ammonia.

Although there has been a quieter tone in the market for this material during last week, the demand has proved to be sufficient to absorb current production at the level of prices attained a week ago. Direct inquiry has shown some falling-off in volume; but middlemen have still seemed to have been in want of January supplies. At the close, the values are £14 7s. 6d. to £14 8s. 9d. per ton f.o.b. Hull, £14 8s. 9d. to £14 10s. per ton f.o.b. Liverpool, and £14 11s. 3d. to £14 12s. 6d. per ton f.o.b. Leith. For future delivery, producers have now assumed a very firm attitude, and are quoting £14 12s. 6d. per ton f.o.b. at the principal ports for January-June in equal monthly quantities, but no business has transpired at this figure.

Nitrate of Soda.

On spot, the market for this article has hardened somewhat, and the quotations have been raised to 10s. 1½d. per cwt. for ordinary, and 10s. 4½d, for refined quality.

LONDON, *Jan.* 22.

Tar Products.

The markets for tar products are still very firm. There has been a further improvement in pitch, and better prices have been paid at nearly all ports. Benzols are slightly weaker; and several parcels have been offered at lower prices without finding buyers. Solvent naphtha is firm; and there is a fair amount of inquiry for this article. Creosote is in good demand; and high prices are reported to have been paid for export shipment. Crude carbolic remains in about the same position; and a few transactions have transpired for delivery over the atter part of the year.

The average values during the week were: Tar, 23s. 3d. to 27s. 3d. *ex* works. Pitch, London, 44s. to 44s. 6d.; east coast, 43s. to 43s. 6d.; west coast, Clyde 41s. 6d. to 42s. 6d., Manchester 41s. 6d. to 42s. 6d., Liverpool 42s. 6d. to 43s. 6d. Benzol, 90 per cent., naked, London, 11d.; North, 10d. to 10¼d.; 50-90 per cent., naked, London, 10d. to 10½d.; North, 9½d. to 10d. Toluol, naked, London, 10d.; North, 8½d. to 9d. Crude naphtha, in bulk, London, 4½d. to 5d.; North, 3¾d. to 4½d. Solvent naphtha, naked, London, 11d. f.o.b.; North, 10d. to 10¼d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. 0¼d. f.o.b.; North, 10d. to 10¼d. f.o.b. Creosote, in bulk, London, 2⅝d. to 3⅛d.; North, 2½d. to 2⅝d., salty; 2⅝d. to 2¾d., liquid. Heavy oils, in bulk, 3¼d. to 3⅜d. Carbolic acid, casks included, 60 per cent., east coast, 3s.; west coast, 3s. Naphthalene, £4 10s. to £10; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1½d. to 2d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has been a firm tone in the market; and prices have improved to the extent of 1s. 3d. to 2s. 6d. per ton at all ports. Actual Beckton is quoted at £14. Outside London makes are £13 12s. 6d.; Leith, £14 10s.; Liverpool, £14 7s. 6d. to £14 8s. 9d.; Hull, £14 7s. 6d.; Middlesbrough, £14 7s. 6d. to £14 10s,

COAL TRADE REPORTS.

Northern Coal Trade.

The Northern coal trade has been brisk and excited; but the stormy weather has prevented shipments, and caused a temporary dulness in this branch of the trade. In steam coals, best Northumbrians have thus been brought to easier prices. Steam smalls are relatively high at from 7s. to 9s. 6d. per ton. Work at the collieries was very brisk; but the stoppages of steamers made an alteration in some pits in this respect. In the gas coal trade, the demand has naturally been very strong at this season of heavy consumption, with the labour trouble added. Prices rose rapidly, but were checked at the end of the week by the cause already referred to. Now best Durham gas coals may be quoted as about 14s. 6d. per ton f.o.b.; while second-class coals are about 13s. to 13s. 6d. The tenders have been decided for the Copenhagen gas coal contracts. The quantity is nearly 200,000 tons; and this total is allotted to special Wear coals generally, at prices that are believed to vary from 16s. 10d. to 17s. 3d. per ton delivered. This is fully 2s. 6d. above the price of last year's contracts; the advance being due to higher freights as well as dearer coals. Coke is steady. Gas coke has been in very strong demand; so that 15s. 3d. per ton f.o.b., and even more, is quoted for good makes.

Scotch Coal Trade.

The demand for all classes of coal has been very brisk during the week, and household kinds show advances of from 2s. to 3s. per ton, while dross has gone up from 1s. 3d. to 1s. 9d. per ton. Coalmasters are practically only selling from day to day; and orders are being booked at prices ruling at the date of despatch. At many of the pits the supply is inadequate. Prices may be quoted as follows: Ell, 13s. to 14s. 6d. per ton f.o.b. Glasgow (according to quality); splint, 13s. to 14s.; steam, 12s. to 13s. Prices for f.o.b. Leith cannot be given with accuracy, as they vary in accordance with the position in which collieries find themselves individually; but all grades show sharp advances, ranging approximately from 1s. 6d. to 2s. 6d. per ton. At a number of the pits, no sales are being made for delivery after February unless subject to exemption in the event of strikes or stoppage of work at the collieries.

In the Chancery Division of the High Court of Justice last Tuesday, Mr. Justice Neville made an order for the compulsory winding-up of Howellite Burners, Limited. It was stated that the paid-up capital of the Company was £2000, and that a Receiver of all the assets had been appointed on behalf of a creditor for £200.

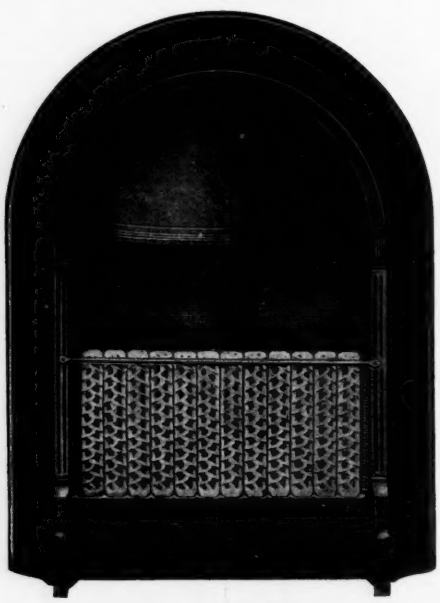
ARDEN HILL'S new "O-K" SERIES of Gas Fires.

THE VERY LATEST INVENTION IN HEATING BY GAS.

Fitted with the new **"Helium"** Radiants (Regd. Design) which give pure and perfect Radiant heat—warming the room without drying the air.

Great heat for little gas

EFFICIENCY.



Little gas for great heat

ECONOMY.

The "Kalo" Gas Fire is similar in design to the "Olak," but is of square shape.

Send for Price Lists:
ARDEN HILL & CO.,
ACME WORKS,
BIRMINGHAM.

The "OLAK."

Electric Free Wiring Agreements.

The Swansea Gas Company have jointly with the Canterbury Gas and Water Company presented a memorial complaining of non-compliance with Standing Orders in the case of the petition deposited for the Bill of the National Electric Construction Company, Limited. The promotion of the Bill is alleged to have become necessary owing to doubts which have arisen as to whether a large number of agreements entered into between the Electric Free Wiring Syndicate, Limited, and 25 local authorities "were within the powers of the several parties" to undertake. The object of these agreements was to supply the necessary electric wires to the premises of any consumer taking his supply from a public authority, upon terms which theoretically involved "no charge" to the public authority or the consumer; the cost being defrayed by the payment to the Syndicate by the local authority of ⅛d. on every unit of electricity supplied to a consumer. The Syndicate having transferred to the National Electric Construction Company the benefit of these agreements, Parliament is now to be asked to remove all doubts as to their validity by confirming them, as £75,000 of debentures are held by the public upon this security. Among these agreements is one entered into with the Corporation of Swansea on Jan. 23, 1901. The Company allege that the notice given by the promoters of their intention to bring forward this Bill is "misleading and defective, and does not comply with the Standing Orders."

Extension of the Buxton Gas-Supply Area.—A Local Government Board inquiry was held last Thursday at Buxton, by Mr. R. C. Maxwell, into an application by the Buxton Urban District Council for a Provisional Order to enable them to include Fernilee in their limits of gas supply. The Clerk to the Council (Mr. J. Taylor) detailed the case, and explained the boundaries of the district it was proposed to cover. He said the price of gas was 3s. 6d. per 1000 feet, less 10 per cent. It was mentioned that all gas-works extensions had been paid for out of revenue during the past seven years—the cost amounting to £6000.

Chislehurst District Council and the Proposed Gas Amalgamation.—At the meeting of the Chislehurst Urban District Council on Monday last week, the Finance Committee reported that the Clerk had laid before them a copy of the Bill which is being promoted by the South Suburban Gas Company for the acquisition by them of the undertakings of the Bromley and Crays and the West Kent Gas Companies, and submitted a report showing how the district would be affected by the provisions of the Bill. He also read a letter from the Bromley Borough Council stating that they had decided to oppose the Bill, suggesting the desirability of a conference of local authorities interested, and asking the Council to appoint two representatives to attend it. The Committee decided to ask two members to attend the conference, and recommended that their action be confirmed and that the Council should seriously consider whether or not they would oppose the Bill. The recommendation was adopted.

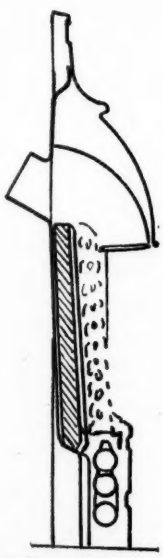
Death from an Electric Shock.

The Coroner for the South-Eastern District (Dr. H. R. Oswald) recently held an inquiry concerning the death of Ernest Thomas Killick, aged 26, of 58, Ordnance Road, East Greenwich, a coach fitter in the service of the London County Council. Mr. H. D. Durrant, the landlord of a public-house, stated that several of his electric lamps and switches got out of order, and Killick came to the house to put them right. Witness told him to be careful when repairing the lamp at the rear of the house, because he had himself received a shock on touching the bracket. About 9.15 witness heard cries of "Help!" and "Switch off!" and on going outside saw Killick and the barman lying on the ground. Killick was carried into the house, and "first aid" was rendered by three employees of the South Metropolitan Gas Company who happened to be on the premises. A telephone message was sent to a medical man, who, on arrival, said Killick was dead. Witness added that he always understood deceased was an electrician. The barman having given evidence, Dr. G. B. Goodall, who had been called in, deposed that he had made an autopsy, which showed that a strong electric current had passed through the body. Death was due to heart failure accelerated by the shock. Mr. W. J. Allbright, the Engineer at the South Metropolitan Electric Light Works, said the voltage of the installation at the house was 200, there was a leakage, and the bracket, in which there was water, was in a very dangerous condition. The circumstances in which the man met with his death were the worst possible. The verdict was "Accidental death."

Felixstowe Water Purchase Question.—At a special meeting of the Felixstowe and Walton Urban District Council last Wednesday, it was decided to take a poll of the ratepayers on the question of proceeding with the Bill for the acquisition of the undertaking of the Felixstowe Water Company, of which notice has been given. At a largely attended public meeting of ratepayers held last Thursday, the opinion was expressed that the purchase of the water-works would impose upon the district a very great burden which it could ill-afford to bear; and those present undertook to use every legitimate means to prevent the passing of the Bill which has been promoted by the District Council to sanction the purchase. A resolution was passed to the foregoing effect.

Coleford Water Supply.—At the last monthly meeting of the Coleford Urban District Council, Mr. W. H. Radford, of Nottingham, attended, and discussed with the Council the question of an improved water supply. He said there was a place near Crow Ash, Berry Hill, 750 feet above the sea, which would be sufficient for the Coleford district, with the exception of a few houses. Speaking roughly, the pumping-station would cost £1000; a main a mile long, £300 or £400; and a reservoir, anything from £3000 to £5000. It would cost the Council £5400 before they had a scheme which would pass the Local Government Board. After some discussion, Mr. Radford was asked to prepare alternative schemes at Crow Ash and Staunton.

COMMON-SENSE and THE HUMP.



Section of D.S.O. Fire. No obstruction between fuel and canopy.

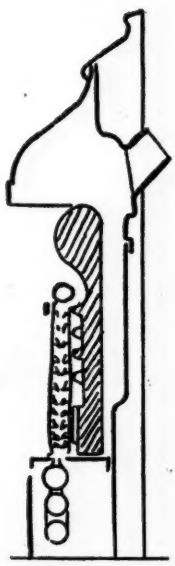
Which is the most likely to carry the products of combustion away:

The Fire with the Hump on the Brick,

or

The Fire with the Fuel sloping up into the Canopy?

(See Article on page 210.)



Section of ordinary type of Fire with hump on brick to obstruct passage to canopy.

R. & A. MAIN, LIMITED.

WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.

SHOW-ROOMS AND BRANCHES: 25, Princes St., Oxford Circus, W.; 136, Renfield St., GLASGOW; 56, Broad St., BIRMINGHAM; 83, Old Market St., BRISTOL; 13, Whitworth St. West, MANCHESTER; 8, Exchange Place, Donegall St., BELFAST; 333, Queen St., MELBOURNE; and 12, Cunningham Lane, Pitt St., SYDNEY, N.S.W.

Gas-Workers' Wages at Newcastle-upon-Tyne.—For some time negotiations have been proceeding between the National Amalgamated Union of Labour and the Directors of the Newcastle and Gateshead Gas Company on the question of an advance of wages and improved conditions of service for the men employed at the Elswick and Redheugh works. The men's application was for an advance of 12½ per cent. for yard labourers, and 10 per cent. for all the men in the carbonizing department, with time-and-a-half for the third shift on Sundays, and ten days' holiday in the year, with pay. The Company made an offer, which was not considered satisfactory by the men. Subsequently, however, other terms were accepted; and the new scale will be in operation as from the first pay-day of the present year. Time-and-a-half has been granted for Sundays. The changes will increase the wages to the extent of £3000 per annum.

Electric Light Failure at Woking.—In a previous issue of the "JOURNAL" attention was called to a failure of the supply of electric energy by the Woking Electric Light Company. We are not aware what steps the Company took to prevent a recurrence of this inconvenience; but, at any rate, they were not effectual, for between ten and eleven o'clock last Thursday evening the light began to flicker, then went out, came on again, flickered, and once more went out. These vagaries continued for some little time, and ultimately the light failed altogether; and the residents depending upon it had to obtain candles and retire. We do not know whether or not it came on again during the night; but between six and seven o'clock on Friday morning there was still no energy obtainable. About the latter hour, however, the supply resumed its normal condition. Possibly some plausible explanation will be forthcoming; but the opinion held locally is that the cables are defective—in fact, absolutely worn out.

A New Fuel Industry at Port Arthur, Canada.—The following particulars have been issued from the Canadian Government Emigration Office, in a leaflet bearing the heading of "Coal War at Port Arthur, Canada": "Owing to the establishment at Port Arthur of a 'coalette' plant which utilizes the coal dust or waste, a new fuel has been put on the market, and has been found to give great satisfaction in the way of eliminating practically all ashes and all clinkers, producing a hotter fire than ordinary coal, and, most important of all, sold at $2 per ton less than the former price of hard coal. This plant is supplying not only Port Arthur and Fort William, but is shipping in train loads to the Western market. The advent of this new fuel has caused a material reduction in the price of anthracite coal. The coal dealers, of course, claim that they are now losing money by selling their coal at $7·25 per ton, compared with $8 before the coalette fuel came on the market. As the coalettes are selling at $6 per ton, the probabilities are that they will have to further reduce the price of hard coal if they are to remain in business. Thus Port Arthur has a new industry established which utilizes what was in the past practically a waste product. The enormous piles of coal dust which have accumulated at the head of the lakes is being turned to use; and the utilization of same is a material reduction in the cost of fuel to the people."

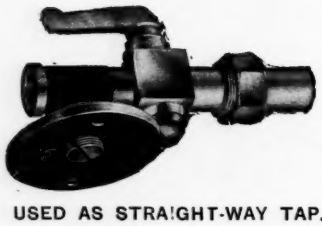
Metropolis Water Supply in 1910.—According to the annual report of the Local Government Board, issued last week, the average population supplied with water by the Metropolitan Water Board during 1910 was 7,081,388. The average daily supply was 223,536,884 gallons; representing a daily consumption of 31·57 gallons per head or 204·24 gallons per house for all purposes. In 1909, the average population supplied was 7,064,013, and the average daily supply 226,481,907 gallons. It will be seen from these figures that the average daily supply in 1910 was nearly 3 million gallons less than that in 1909, though the average population was greater by 17,375 persons. With respect to quality, 15,498 samples of water were examined in the laboratories during 1910; and the results showed that the filtered water derived from the Thames and from the New River was slightly less satisfactory than in 1909. The opposite, however, was the case as regards filtered water derived from the Lea.

Colne Valley Water Company.—At the meeting of this Company on the 6th prox., the Directors will report that the capital expenditure during the six months ended the 31st of December amounted to £2342. In view of the growing demand for water in the district, they consider it necessary to establish the Eastbury pumping-station on permanent lines; and in order to meet the capital expenditure involved, as well as the ordinary capital requirements for the current year, it is proposed to issue the remainder of the £25,000 of capital authorized by the proprietors on Feb. 15, 1910, and to invite tenders for £13,000 of "D" ordinary 7 per cent. stock. The profit on the revenue account is £17,469; and the balance on the dividend and interest account £19,052. Out of the latter sum the Directors recommend the payment of the full statutory dividends of 10 and 7 per cent. per annum, with the addition of 1 per cent. on account of back-dividends on the "A," "B," and "C" stocks; leaving £5603 to be carried forward.

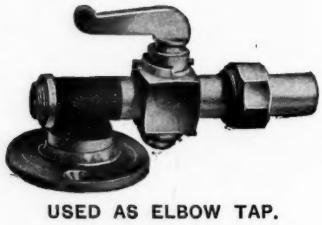
Extensions of Plant at Doncaster.—The rapid development of the Doncaster district has led, and is still leading, to a largely increased consumption of gas in the area served by the Doncaster Corporation. At the last meeting of the Gas Committee, the matter came up for consideration, and steps were taken to deal with the extraordinary demands now being made upon the department. The Gas Engineer (Mr. Robert Watson) was instructed to obtain tenders for the erection of a new gasholder, and also to prepare detailed plans, estimates, and specification with a view to making an early application to the Local Government Board for permission to borrow £10,000 for the purpose of providing additional scrubbing and washing plant, and carrying out other extensions during the present and succeeding years. The great increase in the output of gas during the past twelve months is due to extensive colliery developments, particularly in the outlying parishes of Warmsworth, Edlington, and Bentley. The consumption has been on so large a scale that it could not be foreseen that such an increase in the plant as that above indicated would be required during this year. Last month one day's consumption reached nearly 1½ million cubic feet, which is far above the record of any previous day's output in the gas area.

Something New!

TWO-WAY GAS FIRE TAP.



USED AS STRAIGHT-WAY TAP.



USED AS ELBOW TAP.

The alteration is made by changing the position of screwed plug.

SOLE MAKERS:

SAWER AND PURVES,

NELSON METER WORKS, **MANCHESTER.** RADFORD METER WORKS, **NOTTINGHAM.**

WIRES { "SAWER MANCHESTER." "SAWER NOTTINGHAM." TELEPHONE NOS. { 3289 (City) MANCHESTER. 2025 (Central) NOTTINGHAM.

Agent for Scotland: JNO. D. GIBSON, 2, Causeyside Street, PAISLEY.

According to a paragraph in a London evening paper, each employee of the Barking Gas Company, whose undertaking, it may be remembered, has been acquired by the Gaslight and Coke Company, has received from the Directors a packet containing one week's wages as a parting gift.

It was reported at a meeting of the Ashton District Water-Works Committee last Thursday that up to the present £100,215 has been spent on the construction of the new reservoir in the Chew Valley, and that it is expected the scheme will be completed before the end of the present year.

At a recent meeting of the Rhyl Urban District Council, the report of the Local Government Auditor was received. It showed that at the end of the last financial year the profits on the gas undertaking amounted to £4970, of which sum £2845 was used in the repayment of loans and for interest, and £2125 placed to the credit of the district fund.

We have received from Messrs. Macdonald and Co., of 166, Fleet Street, E.C., a booklet on the Insurance Act. Their intention has been to produce at a popular price a full explanatory digest of the measure, such as will be sufficient for present use and future reference. It is by "An Old Parliamentary Hand;" and special care has been taken by the author to make the Act intelligible to people unaccustomed to the study of Statutes. The price of the book is 6d.

On Monday last week, the Parkinson Stove Company, Limited, held a very successful conference of representatives, presided over by Mr. William Cheshire, a Director. Afterwards dinner was served, with Mr. Cheshire in the chair, and Mr. W. W. Parkinson, a Director, of London, in the vice-chair. This was followed by a programme of music, to which Mr. Cheshire, Mr. Parkinson, Mr. Mawbey (the General Manager), and members of the staff contributed. Altogether a very enjoyable evening was spent.

It is reported that, as the result of the recent heavy rains, there has been a further serious disturbance of the mountain side at Troedrhiwfuwch. In consequence of the movement of the subsoil, the Rhymney and Aber Valleys Gas and Water Company's water-mains, which convey water down the valley from the reservoir at Rhymney Bridge, were dislodged, and over 30,000 inhabitants, residing at Bargoed and the adjacent townships, were deprived of a sufficient supply of water for domestic purposes. On Thursday evening, a large number of men were engaged in making a new track for the mains.

A good opportunity will be afforded next Tuesday of acquiring gas stock, as on that day, as announced elsewhere, Messrs. A. & W. Richards will submit for competition, at the Mart, Tokenhouse Yard, stocks of the Gaslight and Coke Company, the British Gaslight Company, Limited, and the Hornsey Gas Company, which they are selling by order of the Liquidator of the Birkbeck Building Society; also stocks in the Isle of Thanet and Broadstairs Gas Companies, and the Aldershot Gas, Water, and District Lighting Company, which are to be disposed of under instructions of executors.

The public lamps at Milton Regis, Kent, are to be extinguished at midnight, in order to save coal in view of the possibility of a stoppage in the supply owing to the miners' dispute.

The ninth annual dinner of the workmen of the Reading Gas Company was held at the Caversham Bridge Hotel, on Saturday, the 13th inst., under the presidency of Mr. D. H. Helps, Assoc.M.Inst.C.E., the Engineer and Manager. The toast of "The Chairman and Directors of the Reading Gas Company" was proposed by Mr. A. B. Stedman, the Secretary, who mentioned that this year they would celebrate not only the fiftieth year of the Company's existence, but also the completion of this length of service as Chairman by one whom they all honoured and respected—Mr. J. Okey Taylor. Mr. Helps, responding on behalf of the Directors, said he should like to confirm all Mr. Stedman had stated with regard to their Chairman and the other members of the Board, for they all had the workmen's interests at heart. As Mr. Stedman had mentioned, the present year was the fiftieth of the Company's existence, and the Directors were already making arrangements for the increased comfort of the men at the works. Mr. L. A. Rumble proposed "The Chairman," coupling with it the name of Mrs. Helps. Mr. Helps replied, and submitted the toast of "The District Superintendent, Mr. C. H. Eves," which was acknowledged by this gentleman. During the evening, an excellent programme of music was carried out.

APPLICATIONS FOR LETTERS PATENT.

597.—Blumberg, R., "Artificial fuel." Jan. 8.
611.—Armstrong, J., "Discharging and cooling coke." Jan. 8.
618.—Mannesmannlicht G.m.b.H., "Bunsen burners." Jan. 8.
670.—Rhodes, B., "Valves for gas." Jan. 9.
671.—Littleton, H., "Burner." Jan. 9.
673.—Loehlein, G. A., "Gas-producing apparatus." Jan. 9.
712.—Silberrad, O., "Production of relatively non-volatile liquid nitration products from coal tar." Jan. 9.
729.—Anderson, D., "Gas-burners." Jan. 9.
753.—Holmes, W. C., and Co., Ltd., and Howell, H., "Treating water for use in gas-scrubbers." Jan. 10.
850.—Johnson, F., "Tar-recovery." Jan. 11.
860.—Weld, C. G., "Compressing gas." Jan. 11.
890.—Wright, A. C., Hansford, J., and Frost, A. C., "Gas-meters." Jan. 11.
945.—Joyner, C., and Co., and Sturge, W. H., "Rubber connections for flexible gas-tubing." Jan. 12.
959.—Clayton, R., and Crump, E. B., "Gas-fires." Jan. 12.
1026.—Neely, J. G., "Combined gas-lighter for domestic fires and gas-cookers." Jan. 13.
1054.—Plucknett, H. M., "Gas-stoves." Jan 13.
1066.—Campbell, J., "Fire-resisting silica material." Jan. 13.

GAS MANTLES

IN ALL SIZES
TO SUIT
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UNEQUALLED FOR
STREET LIGHTING AND MAINTENANCE.

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Welsbach House, King's Cross, London, W.C.
Telegrams: "Welsbach London." Telephone: North 2410 (4 lines).

We have received from the publisher, Mr. S. Edgecumbe Rogers, of 27A, Farringdon Street, E.C., "Practical Sewerage and Sewage Disposal," by H. C. H. Shinton. The book is intended to be in the nature of a practical handbook, giving definite advice, as far as possible, to those who have actually to carry out work. The price of the book is 3s. 6d. net.

It is always a pleasure to direct attention to the gradual progress made by an old-established firm; and it is particularly so in the case of that of Messrs. William Sugg and Co., Limited, who have held a very conspicuous place in connection with the gas industry for about three-quarters of a century. Evidence of this progress is afforded by a *souvenir* booklet which they have just issued, containing some historical notes of the work done by the firm, especially under the direction of the late Mr. William Sugg, who, in 1858, succeeded to the business founded by his father in 1837. From the small beginning in Marsham Street, Westminster, the concern grew until a move was necessitated to the well-known Vincent Works, where the inventive genius of the guiding spirit of the establishment, applied to the production of improved gas-burners, brought an expansion of business and a universal reputation. The quality of the Company's productions is shown by the fact that no fewer than 79 highest awards, including 28 gold medals, have been gained for their specialities. In order to be in a position to cope with the increased demands upon them, the workshops have been enlarged from time to time till the floor-space is now about 70,000 square feet. The various shops, of which some well-executed views are given, are thoroughly equipped with the latest machinery and appliances; so that not only are the Company able to deal with all matters relating to lighting, heating, cooking, and ventilating by gas, as well as its testing, but also with foundry work and general engineering. The booklet, which has for its title "Explanation and Invitation," is altogether an interesting and artistic production from every point of view.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending Jan. 20. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast.	
					Liverpool.	Manchester.
Tar, crude	per ton	—	23/- 27/6	24/- 28/-	—	24/- 27/6
Pitch	"	44/-	43/6	45/3	—	—
Benzol, 90%	per gallon	1/1⅜	1/0½	1/-	1/-	-/11⅜
Benzol, 50-90%	"	—	-/11	-/11	-/11	-/10⅞
Toluol, 90%	"	—	-/10½	-/11	—	-/10¼
Crude naphtha, 30%	"	—	-/5	-/4½	-/5	-/5
Light oil, 50%	"	—	-/4⅜	—	-/4⅜	-/4⅜
Solvent naphtha, 90-160	"	—	-/11	-/10½	—	-/10⅝
Heavy naphtha, 90-190	"	—	-/11	-/11	—	-/11¼
Creosote in bulk	"	-/3¼	-/2⅝	-/2 9/16	-/2⅝	-/2⅝
Heavy oils	"	—	-/2⅜	-/2⅜	—	-/2⅞
Carbolic acid, 60's	"	—	3/1½	3/-	2/10	2/10
Naphthalene, crude drained salts	per ton	—	45/-	42/6	47/6	50/-
" pressed	"	—	60/-	63/-	60/-	60/- 75/-
" whizzed	"	—	—	—	71/3	65/- 75/-
Anthracene	per unit	-/2	-/1½	-/1½	-/1¼	-/1¼

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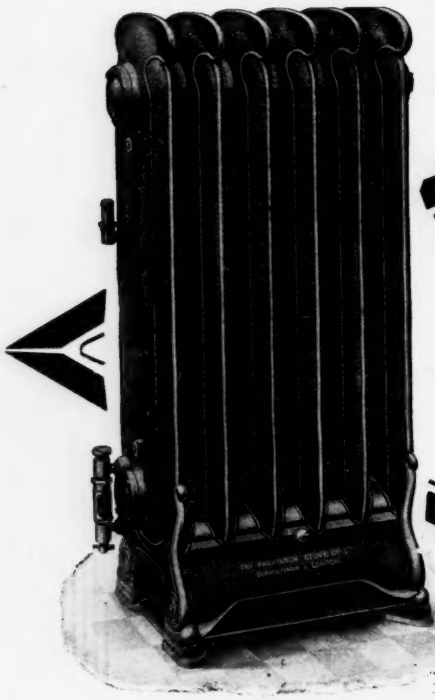

are always chosen by Consumers on account of their Scientific Construction, Expert Workmanship, and High-class Materials, which ensure

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WITH
THE LOWEST GAS CONSUMPTION.

GIVE ENTIRE SATISFACTION.

The PARKINSON STOVE CO., Ltd.
BIRMINGHAM & LONDON,

In addition to those acknowledged in the first issue of the "JOURNAL" published this year, we have received diaries, calendars, &c., from the following firms: Messrs. Thomas Glover and Co.; Messrs. R. & A. Main; Messrs. Peckett and Sons; Messrs. Parkinson and W. & B. Cowan; Parkinson Stove Company; Sutherland Meter Company; Messrs. Joseph Taylor and Co.; and Zentrale für Gasverwertung Eingetragener Verein. Messrs. R. & A. Main send a specimen of a special cover made to take their various booklets, which they intimate can be had by readers on application. Messrs. Glover and Co. forward a "Gothic" triplicate telegram book, copies of which can also be had.

GAS COMPANIES' STOCK AND SHARE LIST.

The Stock Exchange had a better time last week than in the week before; but it was not wholly satisfied, and, in regard to the volume of business, it would—like Oliver Twist—have "asked for more." But the tendency was more cheerful in the more important markets; while Buses and other specials furnished attractive excitement. The strong points were the firmness of the gilt-edged class, and the recovery in Railways, which was clenched at the close by the agreement in the cotton dispute. The opening on Monday gave some promise, and the tone continued favourable. Government issues were strong, and Consols gained ¼. Rails reopened with the same cheerfulness that marked the close on the Saturday before; and prices were uniformly, though moderately, higher. Tuesday was rather undecided at first, but strengthened later. Gilt-edged pointed the way, and Consols rose ⅛. Rails were impatient of the tedious drag in the cotton negotiation, but pleased with satisfactory returns. Americans were better. Wednesday was not active, but there was a nice tone. Government issues were still going strong; Consols were up another ⅛; and Rails content with the aspect of labour negotiations. Americans were still improving. Thursday was very quiet; but the tendency was good. Gilt-edged held firm. Rails moved to dividend announcements rather than strike news. Americans got uneven. Friday was very inactive except in the special attractions of the Miscellaneous Market; but Consols rose ⅛ in response to inquiries. Saturday was very quiet and firm. Government issues were strong, Consols closed unchanged at 77⅜ to 77⅝—a rise of ⅜ in the week; and Rails were cheerful. On the Money Market, there was a fair demand which kept rates firm, and discount terms were steady. Business in the Gas Market was fairly up to the normal in point of activity, and the general tendency was good, though movements were not uniformly upward, owing to exceptional circumstances. In Gaslight and Coke, the ordinary was moderately active and quite firm, transactions ranging within the limits of 105⅝-6½. The announcement that the Company would pay the same rate of dividend, and would carry forward a balance higher by £27,000 than that brought forward six months ago, came too late to affect the price. The secured issues were very active; the maximum realizing from 85½ to 87, the preference from 103 to 104, and the debenture from 79⅝ to 80½. South Metropolitan was moderately busy at 116 to 117; and the debenture marked 79¼. In Commercials, there were only two bargains in the 4 per cent. at 111½. Among the Suburban and Provincial group, Brentford old was done at 261 (a rise of 1), Bromley "A" at 129, and Wandsworth and Putney debenture at 72¼. On the local Exchange, Tynemouth changed hands at 115. In the Continental companies, Imperial was quiet and rather weaker at 190 to 191¾ (a fall of 1), ditto debenture was done at 91, Union at 80, and European at 20¾. Among the undertakings of the remoter world, Cape Town preference marked 4¾, ditto debenture 76 and 76½, Primitiva from 7 7/16 to 7 9/16, ditto preference from 5 3/16 to 5 5/16, ditto debenture 98, and San Paulo 11.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 12	5	Alliance & Dublin Ord.	79—82	..	6 1 11
374,000	Stk.	Jan. 12	4	Do. 4 p.c. Deb.	91—93*	..	4 6 0
250,000	5	Sept. 28	7	Bombay, Ltd.	6—6½	..	5 7 8
50,000	10	Aug. 31	15	Bourne- mouth Gas & Water Pref. 6 p.c.	29—30	..	5 0 0
311,810	10	"	7		16¼—16¾	..	4 3 7
75,000	10	"	6		14¼—14¾	..	4 1 4
380,000	Stk.	Aug. 16	13	Brentford Consolidated	257—262	+1	4 19 3
330,000	"	"	10	Do. New	198—203	..	4 18 6
50,000	"	"	5	Do. 5 p.c. Pref.	120—122	..	4 2 0
206,250	"	Dec. 14	4	Do. 4 p.c. Deb.	97—99	..	4 0 10
220,000	Stk.	Aug. 31	11	Brighton & Hove Orig.	217—222	..	4 19 1
246,320	"	"	8	Do. A Ord. Stk.	157—160	..	5 0 0
490,000	20	Sept. 28	12½	British	44½—45½	..	5 9 11
120,000	Stk.	Dec. 29	4	Do. 4 p.c. Deb. Stk.	92—94	..	4 5 1
109,000	"	Aug. 16	6	Bromley, A 5 p.c.	127—132	..	4 10 11
165,700	"	"	4½	Do. B 3½ p.c.	97—102	..	4 8 3
82,278	"	"	5½	Do. C 5 p.c.	117—122	..	4 10 2
55,000	"	Dec. 29	3½	Do. 3½ p.c. Deb.	80—82	..	4 5 4
250,000	Stk.	"	4	Buenos Ayres 4 p.c. Deb.	94—96	..	4 3 4
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4¼—5¼	..	—
100,000	Stk.	Dec. 29	4½	Do. 4½ p.c. Deb. Stk.	76—80	..	5 12 6
157,150	Stk.	Aug. 16	5	Chester 5 p.c. Ord.	111—113	..	4 8 6
1,513,280	Stk.	"	5/9/4	Commercial 4 p.c. Stk.	110—112	..	4 17 7
560,000	"	"	5¼	Do. 3½ p.c. do.	105—107	..	4 19 8
475,000	"	Dec. 14	3	Do. 3 p.c. Deb. Stk.	75—77	..	3 17 11
800,000	Stk.	"	4	Continental Union, Ltd.	80—85	−3½	4 14 2
200,000	"	"	7	Do. 7 p.c. Pref.	132—134	..	5 4 6
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,000	"	—	4	Do. Deb. Stk.	104—105	..	3 16 2
840,150	10	July 28	10	European, Ltd.	20—21	..	4 15 3
16,160,600	Stk.	Aug. 16	4/14/8	Gas-light and Coke Ord.	105½—106½	..	4 8 10
2,600,000	"	"	3½		85—87	+½	4 0 6
4,062,235	"	"	4		102—104	..	3 16 11
4,531,705	"	Dec. 14	3		79—81	..	3 14 1
258,740	Stk.	Sept. 14	5	Hastings & St. L. 3½ p.c.	95—97	..	5 3 1
82,500	"	"	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Oct. 12	11	Hongkong & China, Ltd.	17—17½	..	6 5 9
131,000	Stk.	Sept. 14	7½	Ilford A and C	154—157	..	4 15 6
65,780	"	"	6	Do. B	125—128	..	4 13 9
65,500	"	Dec. 29	4	Do. 4 p.c. Deb.	92—94	..	4 5 1
4,940,000	Stk.	Nov. 10	9	Imperial Continental	190—192	−1	4 13 9
1,235,000	Stk.	Aug. 16	3½	Do. 3½ p.c. Deb. Red.	90—92	..	3 16 1

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
200,342	Stk.	Aug. 31	6	Lea Bridge Ord. 5 p.c.	125—130	..	4 12 4
561,000	Stk.	Aug. 16	10	Liverpool United A.	219—221	..	4 10 6
718,100	"	"	7	Do. B.	163—165	..	4 4 10
306,083	"	Dec. 29	4	Do. Deb. Stk.	100—102	..	3 18 5
75,000	5	Dec. 14	6	Malta & Mediterranean	4½—5	..	6 0 0
560,000	100	Oct. 2	5	Met. of 5 p.c. Deb.	100—102	..	4 18 0
250,000	100	"	4½	Melbourne 4½ p.c. Deb.	100—102	..	4 8 3
541,920	20	Nov. 10	3½	Monte Video, Ltd.	12—12½	..	5 12 0
1,775,892	Stk.	July 28	4⅜	Newc'tle&G'tesh'd Con.	102—104	+½	4 4 2
529,705	Stk.	Dec. 29	3½	Do. 5½ p.c. Deb.	85—87	..	4 0 6
55,940	10	Aug. 31	7/7/0	North Middlesex 7 p.c.	14½—15½	..	4 14 10
300,000	Stk.	Dec. 14	8	Oriental, Ltd.	134—136	..	5 17 8
60,000	5	Sept. 28	8	Ottoman, Ltd.	6⅞—7¼	..	5 10 4
31,800	53	Aug. 16	13	Portsea Island A	140—145	..	4 14 10
60,000	50	"	13	Do. B	133—138	..	4 14 2
100,000	50	"	12	Do. C	130—135	..	4 8 11
398,490	5	Oct. 12	8	Primitiva Ord.	7 3/8—7 5/8	..	5 4 11
796,980	5	Dec. 29	5	Do. 5 p.c. Pref.	5¼—5⅝	..	4 13 0
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	97—99	..	4 0 10
312,650	Stk.	Dec. 29	4	River Plate 4 p.c. Deb.	94—96	..	4 3 4
250,000	5	Sept. 28	12	San Paulo, Ltd.	10⅞—11¼	+¼	5 6 8
115,000	10	"	6	Do. 6 p.c. Pref.	11½—12	..	5 0 0
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.	49—50	..	5 0 0
135,000	Stk.	Aug. 31	10	Sheffield A	239—241	..	4 3 0
209,984	"	"	10	Do. B	239—241	..	4 3 0
523,500	"	"	10	Do. C	239—241	..	4 3 0
90,000	10	Sept. 28	6	South African	8—9	..	6 13 4
6,429,895	Stk.	Aug. 16	5/9/4	South Met., 4 p.c. Ord.	116—118	..	4 12 8
1,895,445	"	Jan. 12	3	Do. 3 p.c. Deb.	78—80*	..	3 15 0
209,820	Stk.	Aug. 16	8½	South Shields Con. Stk.	157—159	..	5 6 11
605,000	Stk.	"	5½	S'th Suburb'n Ord. 5 p.c.	121—123	..	4 12 0
60,000	"	"	5	Do. 5 p.c. Pref.	117—120	..	4 3 4
117,058	"	Jan. 12	5	Do. 5 p.c. Deb. Stk.	119—121	..	4 2 8
502,310	Stk.	Nov. 10	5	Southampton Ord.	107—109	..	4 11 9
120,000	Stk.	Aug. 16	7½	Tottenham A 5 p.c.	145—148	..	4 16 3
483,940	"	"	5⅝	and B 3½ p.c.	115—117	..	4 16 1
149,470	"	Dec. 29	4	Edmonton 4 p.c. Deb.	94—96	..	4 3 4
182,380	10	"	5	Tuscan, Ltd.	8½—9	..	5 11 1
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	97—99	..	5 1 0
236,476	Stk.	Aug. 16	5	Tynemouth, 5 p.c. max.	114—116	..	4 6 2
255,636	Stk.	Aug. 31	6⅝	Wands- B 3½ p.c.	142—145	..	4 14 10
85,766	"	Dec. 29	3	worth 3 p.c. Deb. Stk.	71½—73½	..	4 1 8

Prices marked * are "Ex. div."

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

MANAGER. Guisborough Gas Company. Applications by Feb. 1.
MANAGER (Incandescent Mantle Factory). No. 5512.
DRAUGHTSMAN. Firth Blakely, Sons, and Co., Thornhill.
SHOWROOM SALESMAN (Gas Undertaking). No. 5511.
GAS-FITTER. No. 5513.

Appointments Wanted.

MANAGER, SUPERINTENDING ENGINEER, OR REPRESENTATIVE. No. 5514.
CHEMIST (Analytical Tests, &c.) R. Walker, Farnley.
CHEMICAL PLUMBER, &c. No. 5492.
COMMERCIAL MAN (with Investment if desired). No. 5503.

Meetings.

BARNSTAPLE GAS COMPANY. Bridge Hall, Barnstaple. Feb. 17. Twelve o'clock.
BROMLEY AND CRAYS GAS COMPANY. Bell Hotel, Bromley. Feb. 1. 6 o'clock.
SOUTH METROPOLITAN GAS COMPANY. De Keyser's Hotel. Feb. 14. Two o'clock.
SOUTH SUBURBAN GAS COMPANY. De Keyser's Hotel. Feb. 2. Three o'clock.

Plant, &c. (Second Hand), for Sale.

RETORT HOUSE FITTINGS, CONDENSERS, EXHAUSTERS, WASHERS AND SCRUBBERS, PURIFIERS, METERS, WATER-GAS PLANT, ENGINES, BOILERS, SULPHATE PLANT, &c. Gaslight and Coke Company, Westminster, S.W.
SULPHATE PLANT, &c. Newport (I. of W.) Gas-Works.

Stocks and Shares.

ALDERSHOT GAS, WATER, AND DISTRICT LIGHTING COMPANY. By Auction. Jan. 30.
BRITISH GASLIGHT COMPANY. By Auction. Jan. 30.
BROADSTAIRS GAS COMPANY. By Auction. Jan. 30.
GASLIGHT AND COKE COMPANY. By Auction. Jan. 30.
HORNSEY GAS COMPANY. By Auction. Jan. 30.
ISLE OF THANET GAS COMPANY. By Auction. Jan. 30.

TENDERS FOR

Coke.

ASHFORD (KENT) GAS DEPARTMENT. Tenders by Feb. 1.

General Stores (Sulphuric Acid, Lime, Steel and Iron, Bolts and Nuts, Tools, Paints, Oils, Asbestos Goods, &c.), &c.

DEVONPORT GAS DEPARTMENT. Tenders by Feb. 10.
INVERNESS GAS COMMISSIONERS. Tenders by Jan. 29.
SALFORD GAS DEPARTMENT.

Mantles, &c.

DEVONPORT GAS DEPARTMENT. Tenders by Feb. 10.

Oil for Gas Making.

DEVONPORT GAS DEPARTMENT. Tenders by Feb. 3.

Pipes, &c.

DEVONPORT GAS DEPARTMENT. Tenders by Feb. 10.

Retort-Bench Additions, &c.

BAKEWELL URBAN DISTRICT COUNCIL. Tenders by Feb. 3.

Tar.

INVERNESS GAS COMMISSIONERS. Tenders by Jan. 29.

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PRACTICAL ADVICE ON GAS-FITTING,

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Assistant Superintendent, City of Leeds Gas Mains and Distribution Department.

The work is the outcome of a number of years' practical training and experience on part of the author, and is an invaluable book for all engaged in the Fitting branch of the Gas Industry.

WALTER KING, "JOURNAL" OFFICES, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

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"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House Old Broad Street, London, E.C. "Volcanism, London."

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